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A Synopsis of *Cousinia* sect. *Serratuloides* (Asteraceae) in Iran

Farideh Attar
Central Herbarium of Tehran University, Department of Botany, Faculty of Sciences, Tehran, Iran. fattar@fos.ut.ac.ir

Ahmad Ghahreman and Kazem Mahdigholi
Central Herbarium of Tehran University, Department of Botany, Faculty of Science, Tehran, Iran

Masoud Sheidai
Faculty of Science, Shahid Beheshti University, Tehran, Iran

Abstract. A synopsis of *Cousinia* Cassini sect. *Serratuloides* Bunge (Asteraceae) is presented. The new species *C. sheidaii* and *C. elburzensis*, collected from Markazi and Mazandaran provinces in Iran, respectively, are described and illustrated, and characters that distinguish them from their nearest relatives are given. A description of the section *Serratuloides* Bunge, an enumeration, and a key to its 13 species are given.

Key words: Asteraceae, *Cousinia*, Iran, section *Serratuloides/Serratuloideae*.

Cousinia Cassini (Asteraceae) is an Irano-Turanian genus of perennial, biennial, or annual herbs comprising about 690 species that grow in the montane areas and deserts of southwestern and central Asia (Attar, 2000). *Cousinia* sect. *Serratuloides* Bunge (as "*Serratuloideae*") was delimited to include 11 species by Rechinger (1972, 1979). With the exception of *C. pterocaulos* (C. A. Meyer) Rechinger f., which grows in both Azerbaijan and Iran, all the remaining species of section *Serratuloides* are endemic to Iran.

Based on recent extensive fieldwork, the examination of numerous herbarium specimens, and extensive anatomical, chromosomal, and pollen studies (Mahdigholi, 2003), we expand the limits of section *Serratuloides* to include the 13 species enumerated here.

Species of *Cousinia* sect. *Serratuloides* have highly restricted distributions in Iran and the Talysh region of Azerbaijan. For example, *C. hypoleuca* Boissier, *C. crispa* Jauberti & Spach, *C. pinarocephala* Boissier, and *C. elburzensis* Attar, Mahdigholi & Ghahreman are confined to the Elburz mountains in northern Iran, Mazandaran province; *C. discolor* Bunge, *C. concolor* Bunge, and *C. adenostegia* Rechinger f. are restricted to the Binaloud mountains in northeastern Iran; *C. irritans* Rechinger f. is endemic to Shahvar mountain in Khorasan province; and *C. sheidaii* Attar, Ghahreman & Mahdigholi is endemic to the Tafresh mountains in Markazi province in central Iran. Most species grow on slopes at 1500–2400 m. Only *C. rechingerae* Bornmueller is distributed in forest margins of Gorgan at 600–900 m (Golestan province, northeastern Iran).

Cousinia sect. **Serratuloides** Bunge, as "*Serratuloideae*," Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 7, 9(2): 32. 1865. TYPE: *Cousinia serratuloides* Boissier.

Perennial, branched herbs. Leaves continuously or interruptedly decurrent, herbaceous or coriaceous, lobed or dentate, spinose, glabrous or arachnoid. Heads few, singular, 1–5(–5.5) cm; flowers 30 to 190; phyllaries 55 to 185; phyllaries exappendiculate,

median phyllaries numerous, indistinctly constricted above the base or middle, gradually attenuate toward apex, olive-green to light or dark brown, ciliate at margin, papillose outside; receptacle bristles scabrous or smooth. Corolla violet, purple, pink, or yellow, limb to 2 × longer than tube; anther tube white, purple, pink or violet. Achenes longitudinally striate, scabrous, marginal ones curved, central ones straight.

KEY TO THE SPECIES OF *COUSINIA* SECT. *SERRATULOIDES* IN IRAN

1a. Leaves herbaceous or herbaceous-coriaceous; receptacle bristles smooth.
  2a. Outer and median phyllaries completely falcate . . . . . *C. rechingerae*
  2b. Outer and median phyllaries not falcate.
    3a. Corolla yellow . . . . . *C. olivieri* DC.
    3b. Corolla purple or violet, rarely white.
      4a. Heads 3.5–5.5(–6) cm diam.
        5a. Leaves interruptedly decurrent, rarely continuous, forming narrow wings . . . . . *C. pinarocephala*
        5b. Leaves continuously decurrent, forming broad wings . . . . . *C. pterocaulos*
      4b. Heads 2–3.5(–4) cm diam.
        6a. Heads cylindrical; phyllaries 100 to 130 . . . . . *C. elburzensis*
        6b. Heads spherical; phyllaries 120 to 180.
          7a. Leaves completely crisped; median phyllaries spreading, rarely reflexed . . . . . *C. crispa*
          7b. Leaves not crisped; median phyllaries reflexed, rarely spreading. . . . . *C. alfredii* Bornmueller & Gauba

1b. Leaves coriaceous; receptacle bristles scabrous or subscabrous, rarely smooth.
  8a. Receptacle bristles scabrous, rarely some bristles smooth.
    9a. Heads 2–2.5(–3) cm diam.; flowers 100 to 140; lower leaf surface arachnoid or rarely glabrous . . *C. irritans*
    9b. Heads 1.5–2(–2.5) cm diam.: flowers 90 or fewer; both leaf surfaces glabrous.
      10a. Median phyllaries spreading-reflexed . . . . . *C. concolor*
      10b. Median phyllaries erect . . . . . *C. adenostegia*
  8b. Receptacle bristles smooth, rarely some bristles scabrous.
    11a. Heads 2–2.5(–3) cm diam.; flowers 80 to 90 . . . . . *C. sheidaii*
    11b. Heads smaller; flowers 30 to 55.
      12a. Both leaf surfaces white-arachnoid; receptacle bristles smooth . . . . . *C. discolor*
      12b. At least one leaf surface not white-arachnoid; bristles scabrous.
        13a. Heads (1.5–)2–2.5 cm diam.; median phyllaries usually spreading; flowers 50 to 70 *C. hypoleuca*
        13b. Heads 1–1.5(–2) cm diam.; median phyllaries usually erect; flowers 30 to 50 . . . *C. serratuloides*

1. Cousinia adenostegia Rechinger f., Fl. Iranica 139A: 151. 1979. TYPE: Iran. Khorasan: Binaloud Mtns., Shaikh Abol-Hassan, 1500–2250 m, 30–31 July 1976, *Terme & Tehrani 35120-E* (holotype, W).

Distribution. Iran, endemic to Khorasan province.

Cousinia adenostegia, which is extremely rare and restricted to the Binaloud mountains, is very closely related to *C. concolor*, from which it is distinguished by having erect instead of spreading-reflexed median phyllaries. The species was not assigned to any section by Rechinger (1979), but all of its characters typically fit the sectional description provided above.

Selected specimen examined. IRAN. **Khorasan:** Neyshabour, Binaloud Mtns., Zoshk to Dizbad, ca. 2100 m, *A. Ghahreman, F. Attar & K. Mahdigholi 25399* (TUH).

2. Cousinia alfredii Bornmueller & Gauba, Repert. Spec. Nov. Regni Veg. 49: 264. 1940. TYPE: Iran. Mazandaran: Kelar Dasht, Alam Kuh, 1300 m, *Gauba 629* (holotype, B; isotype, K).

Distribution. Iran, endemic to Mazandaran province on the southern and northern slopes of Elburz Mountains and known only from the type collection.

Cousinia alfredii is easily distinguished from *C. crispa* by its falcate-squarrose phyllaries.

3. Cousinia concolor Bunge, Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 7. 9(2): 33. 1865. TYPE. Iran. Khorasan: Binaloud Mtns., betw. Neyshabur & Meshhad, July 1858, *A. A. Bunge & Bienert s.n.* (holotype, LE; isotypes, K, P).

Distribution. Iran, Khorasan province, endemic to the southern slopes of the Binaloud mountains.

Cousinia concolor is similar to *C. discolor* but differs in its non-arachnoid habit and uniformly colored leaves.

Selected specimen examined. IRAN. **Khorasan:** Neyshabour, Binaloud Mtns., Pivezhen village, 2100 m, *F. Attar & K. Mahdigholi, 27646* (TUH).

4. Cousinia crispa Jaubert & Spach, Ill. Pl. Orient. 2: 81. 1846. TYPE: Iran. N Tehran, *P. M. R. Aucher-Eloy 4807* (holotype, G; isotypes, K, W).

Distribution. Iran, Tehran province, endemic to the Elburz mountains. *Cousinia crispa* is widely distributed on the southern slopes of the central Elburz mountains.

Selected specimen examined. IRAN. **Tehran:** Haraz rd., E of Tehran, Lasem rd., 2100 m, *F. Attar & K. Mahdigholi 28693* (TUH).

5. Cousinia discolor Bunge, Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 7, 9(2): 33. 1865. TYPE: Iran. Khorasan: subalpine areas above "Dschegar" betw. Neyshabur and Meshhad, July 1858, *A. A. Bunge & Bienert s.n.* (holotype, LE; isotypes, K, P).

Distribution. Iran, Khorasan province, endemic to the Binaloud mountains.

Cousinia discolor is considered a very rare species and is known thus far from the two collections described here (*Bunge & Bienert s.n.*; *A. Ghahreman, F. Attar & K. Mahdigholi 25396*), made 144 years apart.

Selected specimen examined. IRAN. **Khorasan:** Neyshabour Mtns., Dizbad to Zoshk, ca. 2200 m, 8 Aug. 2000, *A. Ghahreman, F. Attar & K. Mahdigholi 25396* (TUH).

6. Cousinia elburzensis Attar, Mahdigholi & Ghahreman, sp. nov. TYPE: Iran. Mazandaran: N slopes of central Elburz Mtns., Eshkvar, 1700 m, *F. Attar & K. Mahdigholi 32192* (holotype, TUH; isotype, TUH). Figure 1.

Herba perennis 20–30 cm alta. Folia herbacea, discoloria, supra viridia, arachnoidea, subtus cinereo-arachnoidea, lanceolato-elliptica, petiolata vel sessilia, superiora reducta. Capitula singularia, terminalia, 2–3 cm diam.; involucrum cylindricum, arachnoideum; phyllaria 100 ad 130, intermedia erecto-patentia, dorso virideo-olivaceo; receptaculi setae laeves. Flores 60 ad 80; corolla 15–18 mm longa, purpurea, tubo 6–8 mm longo, limbo 10–11 mm longo; laciniae 3–5 mm longae; antherarum tubus albus, glaber. Achaenia 4–5 × 1.5–2.5 mm, obovata, cinerea, atrimaculata; pappus caducus.

Perennial, 20–30 cm tall, branched at middle; stem and branches sparsely arachnoid. Leaves herbaceous, discolored, continuously or interruptedly decurrent, upper surface dark green, arachnoid, lower surface grayish green, with dense arachnoid hairs; basal leaves lanceolate, 10–15 × 2–4 cm, pinnatifid or pinnatisect, shortly petiolate, margin dentate, with spines 2–6 mm long; lower stem leaves sessile, lanceolate, 5–7 × 2–3 cm, pinnatisect or pinnatifid, with small and large lobes and spines up to 5 mm long; median leaves lanceolate to elliptic, 3–5 × 1.5–2 cm, pinnatifid or sometimes pinnatisect; uppermost leaves gradually smaller and reduced, near the heads. Heads solitary, terminal, 2–3 cm diam.; involucre cylindrical, arachnoid, 2–2.5 × 1–1.5 cm; phyllaries 100 to 130; outer phyllaries reflexed, 8–12 × 1–2 mm, constricted above the base, gradually tapering to the apex into a long spiny tip, olive green above; median phyllaries erect or erect-spreading, 12–18 mm, olive green, constricted above the base; inner phyllaries erect, 18–21 mm, pale brown, ciliate in middle at margin; receptacle bristles smooth, 15–20 mm. Flowers 60 to 80; corolla purple, 15–18 mm long, tube 6–8 mm, limb 10–11 mm, limb lobes 3–5 mm; anther tube white, glabrous. Achenes 4–5 × 1.5–2.5 mm, obovate, attenuate toward base, gray with black blotches; pappus caducous.

Cousinia elburzensis is most closely related to *C. pinarocephala*, from which it differs by having heads 2–3 (vs. 4–5.5) cm diam., 100 to 130 (vs. 120 to 165) phyllaries, inner phyllaries 18–21 (vs. 21–24) mm long, and 60 to 80 (vs. 100 to 160) flowers per head. Both species have a similar geographical range in Iran.

7. Cousinia hypoleuca Boissier, Fl. Orient. 3: 464. 1875. TYPE: Iran. Tehran: Shahrestanak, s.d., *Kotschy* 557 (holotype, W).

Distribution. Iran, endemic to Tehran province.

Cousinia hypoleuca, which is a fairly common species in the central Elburz mountains, is closely related to *C. serratuloides* (the sectional type). *Cousinia hypoleuca* is readily distinguished from *C. serratuloides* by its erect-spreading phyllaries and larger head.

Selected specimen examined. IRAN. **Tehran:** Karaj, Kandavan pass, 2700 m, *Attar & Mahdigholi 27824* (TUH).

8. Cousinia irritans Rechinger f., Ann. Naturhist. Mus. Wien 57: 72. 1950. TYPE: Iran. Khorasan: Shahrud-Bastam, Raheh, S slope of Shahvar Mtns., above Nekarman, 2700 m, *K. H. Rechinger 5955* (holotype, W).

Distribution. Iran, endemic to Khorasan Province.

Selected specimen examined. IRAN. **Khorasan:** Semnan, Shahrud to Azad-Shahr, Nekarman, 1600 m, *Ghahreman & Attar 21893* (TUH).

9. Cousinia olivieri DC., Prodr. 6: 552. 1838, non *C. olivieri* Jaubert & Spach, Ill. Pl. Orient. 2: t. 172. 1846. TYPE: Iran. 1822, *Olivier s.n.* (holotype, G).

Distribution. Iran, endemic to the central Elburz mountains.

Cousinia olivieri is considered a very rare species and is known thus far only from two collections (*Olivier s.n.*; *F. Attar & K. Mahdigholi 30963*) separated by 180 years. *Cousinia olivieri* is closely related to *C. pterocaulos*, but differs in its yellow corolla.

Figure 1. *Cousinia elburzensis* Attar, Mahdigholi & Ghahreman. —A. Habit. —B. Outer phyllaries. —C. Middle phyllaries. —D. Inner phyllaries. Scale bars: A–D = 1 cm. Drawn from the holotype *Attar, Mahdigholi & Ghahreman 32192* (TUH).

Selected specimen examined. IRAN. **Mazandaran:** Lashgan, 1700 m, 14 July 2002, *F. Attar & K. Mahdigholi 30963* (TUH).

10. Cousinia pinarocephala Boissier, Diagn. Pl. Orient., Ser. 1, 6: 121. 1845. TYPE: Iran. Mazandaran: Allamut Mtns., *P. M. R. Aucher-Eloy 4808* (holotype, G; isotype, W).

Distribution. Iran, endemic to Mazandaran province, widely distributed on the northern slopes of the central Elburz mountains.

Cousinia pinarocephala is closely related to *C. pterocaulos*, but the leaves of *C. pterocaulos* are continuously decurrent, forming broad wings.

Selected specimen examined. IRAN. **Mazandaran:** Kelar Dasht, Rudbarak, 2350 m, *Attar & Mahdigholi 28699* (TUH).

11. Cousinia pterocaulos (C. A. Meyer) Rechinger f., Fl. Iranica, 90: 95. 1979. Basionym: *Carthamus pterocaulos* C. A. Meyer, Verz. Pfl. Casp. Meer. 67. 1831. TYPE: Azerbaijan. Talish, s.d., *C. A. Meyer s.n.* (holotype, LE; isotypes, G, W).

Distribution. Iran, Azerbaijan: Gilan and Tehran provinces. *Cousinia pterocaulos* is widely distributed in Gilan and Mazandaran (Firouz-Kuh, Gaduk pass).

Some plants of *Cousinia pterocaulos* have white corollas and anther tubes, while most of the others have pink or violet flowers. However, because this variation is observed within any given population, this floral color variation is not accorded any formal rank.

Selected specimen examined. IRAN. **Gilan:** Talish, Aghvelar village, 1600 m, *Attar & Mahdigholi 32200* (TUH).

12. Cousinia rechingerae Bornmueller, Repert. Spec. Nov. Regni Veg. 48: 133. 1940. TYPE. Iran. Golestan: betw. Bojnurd & Tappeh Moraveh, 1300 m, s.d., *K. H. Rechinger 1927* (holotype, W).

Distribution. Iran, endemic to Golestan Province. This species is widely distributed along forest margins of Gorgan province.

Cousinia rechingerae is closely related morphologically to *C. alfredii*, but they are distinctly separated by their geographical distributions. *Cousinia rechingerae* is distributed ca. 900 m above sea level at forest margins in northeastern Iran, and *C. alfredii* can be found at above 2000 m elevation in the central Elburz mountains. The two species differ morphologically by the large head (4–4.5 cm) and light green habit of *C. rechingerae* versus the smaller head (2–2.5 cm) and deep green habit of *C. alfredii*.

Selected specimen examined. IRAN. **Golestan:** Gorgan, Kalaleh, before Kaleh Mishan, *Attar & Mahdigholi 28689* (TUH).

13. Cousinia serratuloides Boissier, Diagn. Pl. Orient., Ser. 1, 6: 118. 1846. TYPE. Iran. Elburz Mtns., sine loc., s.d., *P. M. R. Aucher-Eloy 4804* (holotype, G; isotypes, K, W).

Distribution. Iran, endemic to the southern slopes of the central Elburz mountains.

Cousinia serratuloides is a very rare species and is known thus far only from two collections (*P. M. R. Aucher-Eloy 4804*; *Attar & Mahdigholi 32205*). The second gathering was collected 156 years after the type collection.

Selected specimen examined. IRAN. **Tehran:** Haraz rd., before Lasem village, 2400 m, 8 July 2002, *Attar & Mahdigholi 32205* (TUH).

14. Cousinia sheidaii Attar, Ghahreman & Mahdigholi, sp. nov. TYPE: Iran. Markazi province: 15 km to Tafresh from Ashtian, 2350 m, 17 June 1998, *A. Ghahreman & F. Attar 21817* (holotype, TUH; isotype, TUH). Figure 2.

Herba perennis, 50–80 cm alta. Folia coriacea, supra viridia, subtus arachnoidea, lanceolata, sessilia, pinnatifida vel pinnatisecta, superiora diminuta. Capitula singularia, terminalia, spinis late patentibus inclusis 2–2.5(–3) cm diam.; involucrum cylindricum, arachnoideum; phyllaria 80 ad 100, intermedia patenti-erecta, dorso viridio-olivaceo, papilloso-scabro, margine ciliata; receptaculi setae laeves. Corolla purpurea, 17–20 mm longa, tubus longitudine limborum; laciniae 2.5–4 mm longae. Antherarum tubus roseus vel purpureus, glaber. Achaenia 6–7 × 2.5–3 mm, obovata, laevia, indistincte striata, pallide brunnea vel cinerea, atrimaculata; pappus caducus.

Perennial, 50–80 cm tall, branched from middle; stem and branches irregularly furrowed, arachnoid. Leaves coriaceous, discolored, upper surface light green, at first arachnoid, then almost glabrous, lower surface densely arachnoid; basal leaves lanceolate, sessile, 20–30 × 6–8 cm, pinnatifid or pinnatisect, margin dentate with 3–10 mm long spines; lower and median stem leaves 5–25 × 4–5 cm, dentate, with ca. 7 mm long spines; upper leaves gradually smaller near the heads. Heads solitary, terminal, 2–2.5(–3) cm diam. (including spines); involucre cylindrical, arachnoid; phyllaries 80 to 100; outer phyllaries reflexed-spreading, 13–18 mm, 3–3.5 mm wide in widest part, constricted at middle, gradually attenuate toward spinose apex, olive green to light brown above, papillose outside except on lower third, ciliate at margin; median phyllaries spreading-erect, 15–20 mm, olive green to brown on upper half, papillose outside, ciliate at margin; inner phyllaries erect, 20–25 mm, upper half pale brown, papillose at middle, ciliate at margin; receptacle bristles smooth, very rarely scabrous. Flowers 80 to 90; corolla purple, drying yellow, 17–20 mm long, tube and limb equal, lobes 2.5–4 mm; anther tube pink to purple, glabrous. Achenes 6–7 × 2.5–3 mm, obovate, attenuate to the base, almost smooth, indistinctly striate, pale brown to gray, with sparse blotches; pappus caducous.

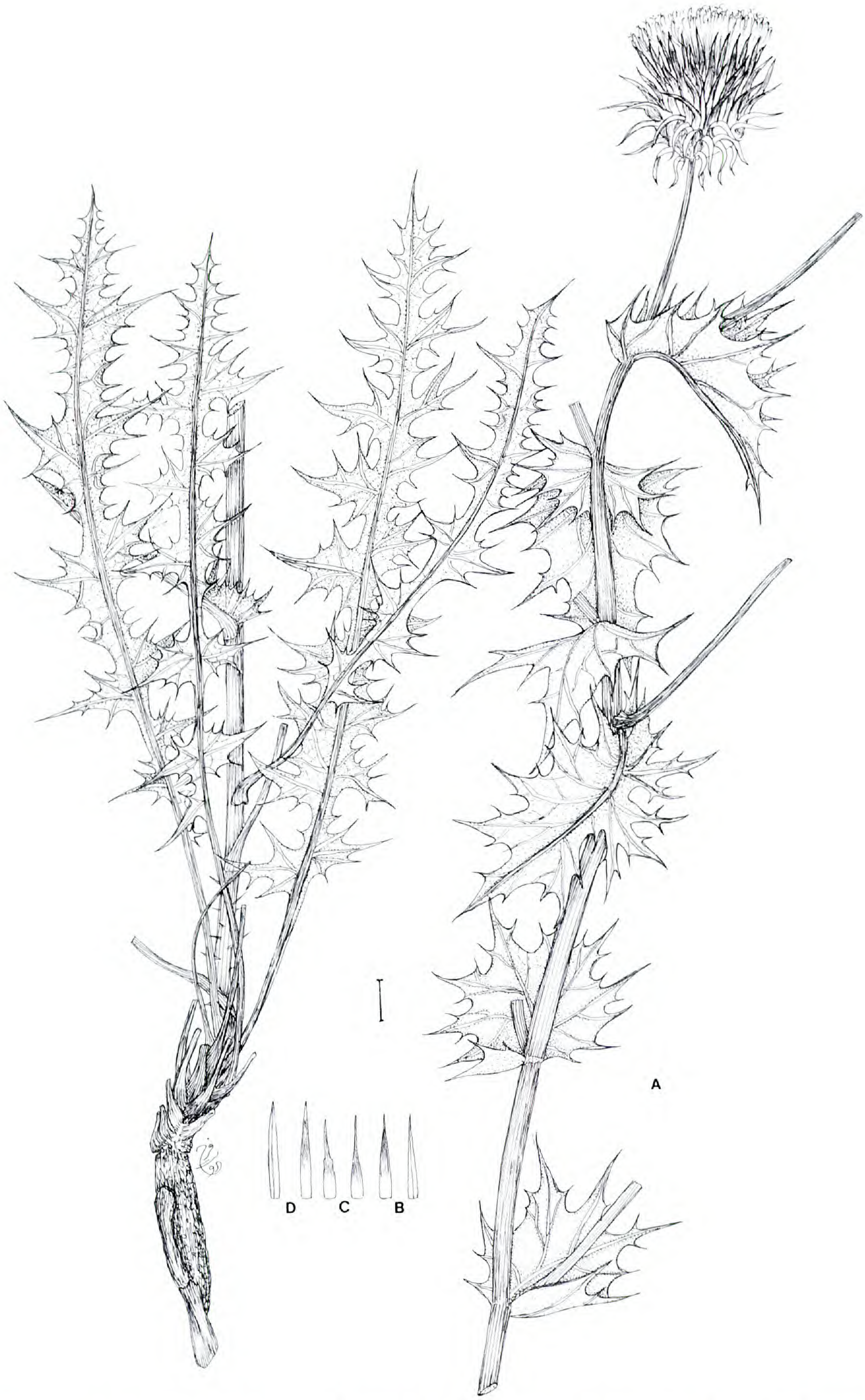

Figure 2. *Cousinia sheidaii* Attar, Ghahreman & Mahdigholi. —A. Habit. —B. Outer phyllaries. —C. Middle phyllaries. —D. Inner phyllaries. Scale bars: A–D = 1 cm. Drawn from the holotype *Attar, Mahdigholi & Ghahreman 21817* (TUH).

Distribution. Iran, Markazi province. This species is restricted to a small patch in the locality of the type specimen.

Cousinia sheidaii is closely related to *C. irritans* and is distinguished by the following characters: outer phyllaries 3–3.5 mm wide (vs. 2.5–3 mm), inner phyllaries 20–25 mm long (vs. 18–20 mm), flowers 80 to 90 (vs. 100 to 140), and pale brown to gray (vs. brown) phyllaries. The geographical ranges of the species are distinct, with *C. sheidaii* restricted to Markazi province (central Iran) and *C. irritans* endemic to Khorasan province (eastern Iran).

Paratype. IRAN. **Markazi:** 8 km from Tafresh to Ashtian, 2610 m, 21 July 2001, *A. Ghahreman, F. Attar & K. Mahdigholi 27610* (TUH).

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A New Species of *Onosma* (Boraginaceae) from Southern Turkey

Rıza Binzet and Nermin Orcan

Department of Biology, Faculty of Science and Literature, Mersin University, 33342 Mersin, Turkey. rbinzet@mersin.edu.tr

ABSTRACT. The new species *Onosma riedliana* Binzet & Orcan (Boraginaceae) in subsection *Asterotricha* (Boissier) Gürke is described and illustrated. The species is restricted to the north of Gülnar (Mersin Province, southern Turkey). Diagnostic morphological characters for detailed discrimination from the most closely similar taxa are discussed.

Key words: Boraginaceae, *Flora of Turkey*, *Onosma*.

In 2003 and 2004 a new species of *Onosma* L. (Boraginaceae) was collected in the Gülnar District, Mersin Province. The plant is asterotrichous (foliar tubercles stellate-pubescent). After thorough consultation of the *Flora of Turkey and the East Aegean Islands* (Riedl, 1978), *Flora Orientalis* (Boissier, 1879), *Flora Europaea* (Ball, 1972), *Flora Iranica* (Reidl, 1974), *Flora of the U.S.S.R.* (Popov, 1974), *Flora of Syria, Palestine, and Sinai* (Dinsmore, 1932), and *Mountain Flora of Greece* (Teppner, 1991), the closest related species to our material appeared to be *O. ovalifolia* Kotschy & Boisier. After comparison with *Onosma* species in ANK, GAZI, ISTE, ISTF, and M, it was decided to describe the material as a new species.

The Boraginaceae are distributed throughout the tropical, subtropical, and temperate regions of the world. The centers of highest diversity in the northern temperate zone are in the Irano-Turanian and Mediterranean regions; in the tropics the Boraginaceae are found in Central America and northern and central South America (Al-Shehbaz, 1991). In Turkey the genus *Onosma* has 100 taxa (96 species, 4 varieties, 1 hybrid species, with 49 endemic species and 1 endemic variety), and the rate of endemism among native species is 50% (Yıldırımlı, 2000; Riedl et al., 2005). Since the genus was revised for the *Flora of Turkey and the East Aegean Islands* (Riedl, 1978), six new taxa have been described, with several new records for Turkey. These include *O. propontica* Aznavour, *O. kaheirei* Teppner, *O. taurica* Pallas var. *viridis* Borbas, *O. mirabilis* A. P. Khokhrjakov, *O. nydeggeri* Huber-Morath, and *O. mersinana* Riedl, Binzet & Orcan.

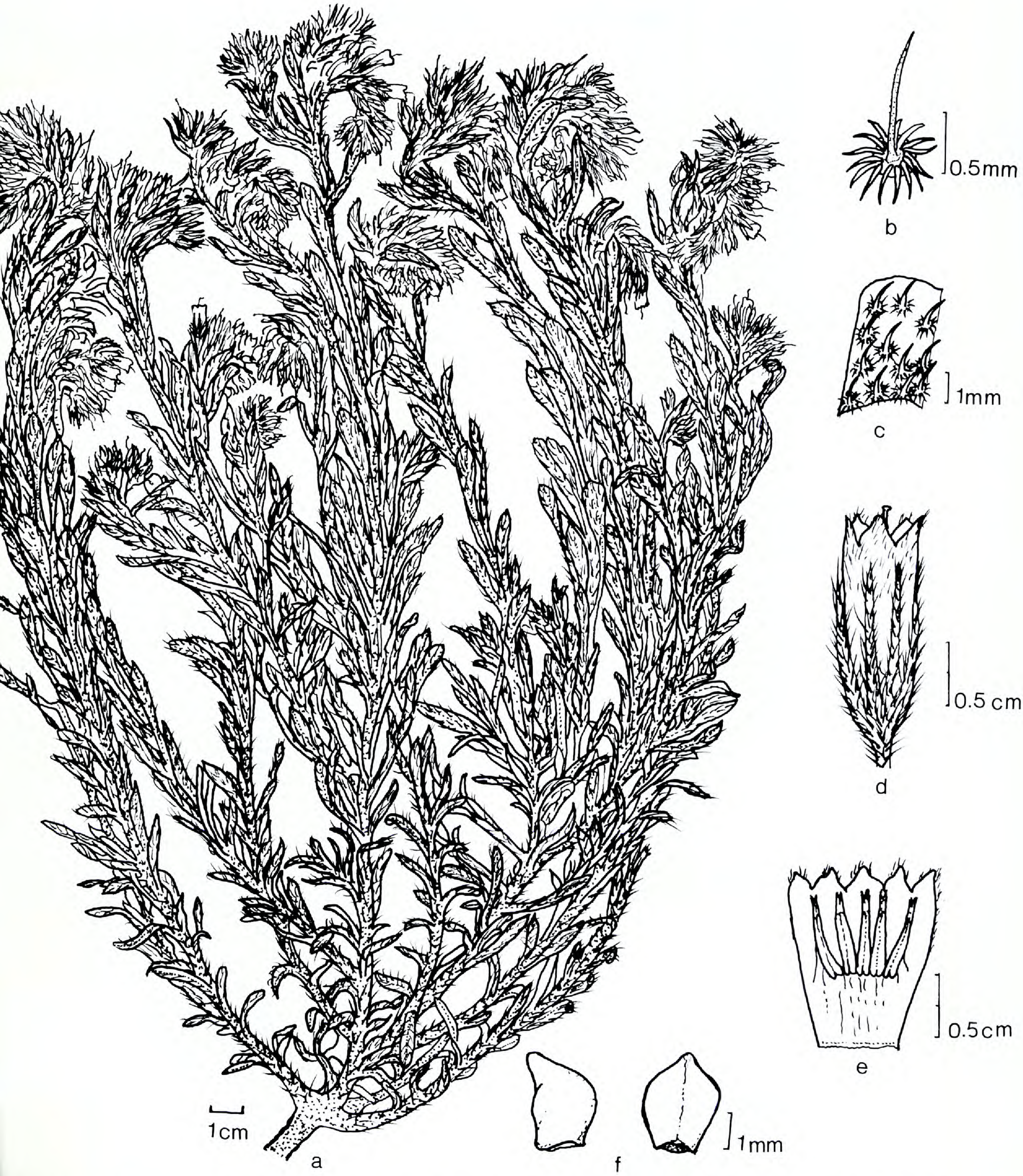
Onosma riedliana Binzet & Orcan, sp. nov. TYPE: Turkey. Mersin Province: Gülnar, Gülnar–Ermenek 42 km, 1450 m, roadside, fallow fields, 24 May 2003, *Binzet G7* (holotype, GAZI; isotypes, GZU, M). Figure 1.

Haec species *Onosmae ovalifoliae* affinis sed caule ramoso (non solitario); foliis 30–50 × 3–8 mm (non 30–60 × 6–18 mm), oblanceolatis-spathulatis (non lanceolatis), setaceis-patentissimus (non subadpressis); inflorescentia 1 ad 3 cymis terminalibus ± scorpioideis (non 1–2 cymis contractis terminalibus); corolla 13–17 mm longa, cremea ad pallidam luteam (non 16–20 mm longa, nivea) differt.

Biennial, stems to 35 cm, branched, pubescent both with patent setae arising from stellate tubercles as well as with short retrorse trichomes. Basal and cauline leaves sessile, 30–50 × 3–8 mm, spatulate to oblanceolate-spatulate, acute, densely pubescent with stellate trichomes each with a patent white to yellowish white seta 1–2.5 mm long and 10 to 15 rays 0.2–0.4 mm long. Inflorescence of 1 to 3 terminal, ± scorpioid cymes; bracts 12–16 mm at anthesis, to 25 mm at fruiting, patent-setose, the setae arising from stellate indument. Pedicel 2–3 mm at anthesis, 2–4 mm at fruiting. Calyx 12–16 × 1–2 mm at anthesis, to 18 × 2–3 mm at maturity; tube white; lobes linear-lanceolate; calyx indument patent-setose, the setae arising from stellate tubercles with 5 to 10 rays; tube indument with patent trichomes at base and with ± appressed setae and short hairs abaxially; lobes with yellowish white ± appressed pubescence; corolla cream to pale yellow, 13–17 mm, cylindrical to subcylindrical, short hairy, anthers included, with elongate bidentate sterile tips, 7 mm, filaments 3–3.5 mm. Nutlets 2.5 × 2 mm, with short beak and dorsal keel, acuminate, gray to pale brown. Pollen type syncolporate, pollen shape subprolate, pollen sculpture reticulate.

Phenology. Flowering occcurs in May; fruiting occurs in June and July.

Habitat and distribution. The new species inhabits roadsides and fallow fields at an altitude of 1450 m. It is endemic to Mersin Province in Turkey, where it is only known from the small area of the type locality.



e 1. *Onosma riedliana* Binzet & Orcan. —a. Habit. —b. Stellate trichome. —c. Indumentum of leaf. —d. Flower. —e. Stamens. —f.
. Drawn from the holotype, *Binzet G7* (GAZI).

Table 1. Comparison of the diagnostic characteristics of *Onosma riedliana* with the related species *O. ovalifolia*.

	O. ovalifolia	*O. riedliana*
Stem	unbranched, setose and shortly pubescent (not retrorse)	branched, patent setose and retrorse pubescent
Leaves	30–60 × 6–18 mm, lanceolate, subappressed setose, shortly hairy	30–50 × 3–8 mm, oblanceolate-spathulate, patent setose, short hairs absent
Inflorescence	1 to 2 terminal, contracted cymes	1 to 3 terminal, ± scorpioid cymes
Bracts	linear to subfiliform	lanceolate to linear
Pedicel	1–1.5(–2) mm	2–4 mm
Sepals	15 mm	12–18 mm
Petals	16–20 mm, whitish	13–17 mm, cream to pale yellow

Etymology. The new species is named in honor of Harald Riedl, who is a senior botanist at Natural History Museum, Vienna.

Onosma riedliana belongs to subsection *Asterotricha* (Boissier) Gürke, which is distributed in Mersin Province in southern Turkey. The closest related species to our new plant appears to be *O. ovalifolia*. *Onosma ovalifolia* can be recognized by its setose and shortly pubescent unbranched stem and lanceolate leaves (30–60 × 6–18 mm) pubescent with subappressed setae and short hairs, while *O. riedliana* has a branched stem with patent setae and short retrorse trichomes and oblanceolate-spathulate leaves (30–50 × 3–8 mm). Detailed comparison of the two species is given in Table 1.

Paratype. TURKEY. **Mersin:** Gülnar, Gülnar-Ermenek 42 km, roadside, fallow fields, 5 June 2004, *Binzet 24* (ANK, MO).

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The Genus *Piper* (Piperaceae) in Honduras

Allan J. Bornstein
Department of Biology, Southeast Missouri State University, Cape Girardeau, Missouri 63701-4799, U.S.A. abornstein@semo.edu

Felix G. Coe
Department of Ecology and Evolutionary Biology, University of Connecticut, 85 Lawler Road, West Hartford, Connecticut 06117-2697, U.S.A. felix.coe@uconn.edu

Abstract. In preparation for a detailed account of the genus *Piper* L. in Honduras, a nomenclator is provided that includes the name, reference citation, and type information for species accepted. A total of 45 taxa are currently recognized, with over 100 names (species level and below) listed in synonymy, 58 of which are new. Lectotypification is provided for the following taxa for which types were not designated at the time of publication: *Piper cobanense* Trelease, *P. cyclophyllum* Trelease, *P. gracillimum* Trelease, *P. perinaequilongum* Trelease, *P. telanum* Trelease, *P. triumphale* Trelease, *P. wilsonii* Trelease, and *P. yzabalanum* C. DC. var. *pubinerve* Trelease.

Resumen. En anticipo al tratamiento detallado del género *Piper* L. en Honduras proveemos un nomenclátor que incluye el nombre, la cita bibliográfica de referencia y la información del tipo para cada especie aceptada. Al momento se reconocen 45 taxones con más de 100 nombres (a nivel de especie y abajo) listados en sinonimia, 58 de los cuales son nuevos. Se provee la lectotipificación para los siguientes taxones para los cuales el tipo no fue asignado al tiempo de su publicación: *Piper cobanense* Trelease, *P. cyclophyllum* Trelease, *P. gracillimum* Trelease, *P. perinaequilongum* Trelease, *P. telanum* Trelease, *P. triumphale* Trelease, *P. wilsonii* Trelease y *P. yzabalanum* C. DC. var. *pubinerve* Trelease.

Key words: Honduras, *Piper*, Piperaceae.

Paul Standley and Truman Yuncker (sometimes with colleagues) collected extensively in Honduras during the late 1920s and 1930s, respectively. As a result of their activities, and because there was a general lack of botanical information from Honduras prior to their efforts, they eventually published several initial floristic treatments (Standley, 1931; Yuncker, 1938, 1940). Both authors received assistance from William Trelease concerning the Piperaceae, as he was recognized at that time as the world authority for the family. Trelease examined virtually all of their collections of the Piperaceae (primarily at the Field Museum (F), the U.S. National Herbarium (US), or the University of Illinois (ILL)), and also separately published an article in which new species were described on the basis of Standley's Honduran material (Trelease, 1929). Although the nomenclatural requirement for type citation (on or after 1 January 1958) did not exist at the time of these various publications, Trelease usually indicated types. Unfortunately, in his treatment of the family for Standley's 1931 publication, no type specimens were specifically mentioned for nine new species, other than a basic reference to their collection locality. While preparing an account of the Piperaceae types in the University of Illinois herbarium, Almut Jones (1985) designated a lectotype for one of these nine names (*Piper quiriguanum* Trelease). We have completed this task by designating eight lectotypes on the following pages for the remaining Trelease names.

In considering which specimens to choose as lectotypes, we consulted the introduction (Standley, 1931), where it is clear that the flora of the Lancetilla Valley was based primarily on Standley collections made in 1927–1928, and that those specimens were "determined and the present flora was written at the Field Museum" (Standley, 1931: 47). Hence, most of our choices for lectotypes are from specimens at F. However, it is also apparent that Standley had access to a series of collections by Percy Wilson of the New York Botanical Garden (NY), made in 1903 in the area near Tela (at that time known as Puerto Sierra). Two of the lectotypes we have designated are based on these Wilson collections, since Trelease specifically annotated these sheets as the "Type."

Anyone who has studied the taxonomic history of the Piperaceae soon comes to the realization that Trelease had a strong tendency to describe new species on the basis of minor variations in morphology, especially vegetative features. In addition, he apparently believed that species were rather limited

in their distribution, with ranges that corresponded to political or geographic boundaries. Therefore, similar collections from neighboring countries would often be described as new simply because they occurred in a different country or region (Standley & Steyermark, 1952). The overall result was the description of numerous species, varieties, and forms from Honduras, most of which had already been described previously. In an effort to update the taxonomy and nomenclature for *Piper* L. in Honduras prior to our formal treatment of the genus, we provide here a nomenclator of species along with extensive synonymy and relevant type information. A total of 45 taxa are recognized, but several of these names (e.g., *Piper biauritum* C. DC., *P. bisasperatum* Trelease, *P. chamissonis* (Miquel) Steudel ex C. DC., *P. chrysostachyum* C. DC., *P. peracuminatum* C. DC., and *P. perhispidum* C. DC.) are included on the basis of tentative identifications.

A similar checklist was published by Nelson Sutherland (2001), but without critical evaluation for many of the taxa. He recognized 54 species of *Piper* in Honduras, and 34 of the names he accepted based on Honduran types have been reduced here to synonymy after comparison with recent treatments of the genus *Piper* from Central America (e.g., Burger, 1971; Callejas, 2001; Tebbs, 1989, 1990, 1993) and our thorough examination of specimens. The only other checklist from Honduras of which we are aware was published by Molina (1975). This is simply a list of names of species (114 total) identified as occurring in Honduras on the basis of collections in the herbarium at Escuela Agrícola Panamericana (EAP), but without any attempt to evaluate the disposition of these names against recent literature concerning the Piperaceae. Of the 114 names Molina included, 20 are recognized here; 64 are reduced to synonymy herein because they are based on types from Honduras; 18 others have been recognized as synonyms in other floristic treatments; four names are ined., having never been published; four are legitimate names as recognized in other recent floristic treatments, but have not been verified by us as occurring in Honduras; one name is an illegitimate homonym (*P. striatum* C. DC.); one is a cultivated taxon (*P. nigrum* L., black pepper); and two are based on sterile specimens, so their exact disposition is uncertain and likely will remain so (*P. rinconense* Trelease and *P. yousei* Trelease).

Piper is generally characterized throughout the Neotropics as a genus of understory shrubs or small trees, or occasionally vines, with swollen nodes and aromatic properties due to the presence of ethereal oil cells; alternate, simple leaves with palmate or pinnate venation; and bisexual, perianth-less flowers usually arranged in leaf-opposed, bracteate spikes, or less often racemes. Each flower consists of two to six stamens and three or four fused carpels. The fruit is a small drupe. This description applies well to the 45 taxa we have recognized below.

1. Piper achoteanum Trelease, J. Washington Acad. Sci. 19: 328. 1929. TYPE: Honduras. Comayagua, El Achote, near Siguatepeque, *P. C. Standley 56125* (holotype, F; isotypes, A, ILL, US).

Piper pictamentum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 352. 1938. TYPE: Honduras. Comayagua, vic. Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5902* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper pictamentum Trelease var. *fluminis* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 352. 1938. TYPE: Honduras. Comayagua, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5718* (holotype, ILL; isotypes, F, GH, MO, NY, US).

Piper yunckeri Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 355. 1938. TYPE: Honduras. Comayagua, near El Achote, hills above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6331* (holotype, ILL; isotypes, F, GH, MO, NY, US).

Piper yunckeri Trelease var. *latum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 355. 1938. TYPE: Honduras. Comayagua, near El Achote, hills above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6333* (holotype, ILL; isotypes, F, GH, MO, NY).

2. Piper aduncum L., Sp. Pl. 29. 1753. TYPE: Jamaica. Plumier, Descr. Pl. Amér., tab. 77. 1693 (lectotype, designated by Saralegui Boza, 2004: 81, tab. 77, in Plumier, 1693).

Piper nonconformans Trelease, J. Washington Acad. Sci. 19: 334. 1929. Syn. nov. TYPE: Honduras. Comayagua, vic. Siguatepeque, *P. C. Standley 55906* (holotype, F; isotypes, A, ILL, US).

Piper multinervium Martens & Galeotti var. *flavicans* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 348. 1938. TYPE: Honduras. Comayagua, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5859* (holotype, ILL; isotypes, F, GH, MO, US).

Piper multinervium Martens & Galeotti var. *hirsuticaule* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 348. 1938. TYPE: Honduras. Comayagua, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5724* (holotype, ILL; isotypes, F, GH, MO, US).

Piper multinervium Martens & Galeotti var. *paralense* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 348. 1938. TYPE: Honduras. Cortés, near Paral, Lake Yojoa, *T. G. Yuncker 4877* (holotype, ILL not seen; isotype, NY).

Piper multinervium Martens & Galeotti var. *peracutum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 349. 1938. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 54921* (lectotype, designated by Jones, 1985: 59, ILL; isotypes, F, US).

Piper multinervium Martens & Galeotti var. *productipes* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 349. 1938. TYPE: Honduras. Comayagua, near El Achote,

above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5819* (holotype, ILL; isotypes, F, GH, MO).

Piper multinervium Martens & Galeotti var. *protractifolium* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 349. 1938. TYPE: Honduras. Comayagua, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5668* (holotype, ILL; isotypes, F, GH, MO, US).

Piper multinervium Martens & Galeotti var. *puberulipedunculum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 349. 1938. TYPE: Honduras. Comayagua, El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5876* (holotype, ILL; isotypes, F, GH, MO).

Piper multinervium Martens & Galeotti var. *pubescenticaule* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 350. 1938. TYPE: Honduras. Comayagua, Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5731* (holotype, ILL; isotypes, F, GH, MO).

Piper multinervium Martens & Galeotti var. *telanum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 350. 1938. TYPE: Honduras. Atlántida, Tela, *P. C. Standley 53264* (holotype, F; isotypes, ILL, US).

3. Piper aequale Vahl, Eclog. Amer. 1: 4, pl. 3. 1797. TYPE: Montserrat, *J. Ryan s.n.* (holotype, C not seen; isotype, IDC 2201: 54.6).

Piper atrichopus Trelease, J. Washington Acad. Sci. 19: 330. 1929. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 54594* (holotype, F; isotypes, A, ILL, US).

Piper epilosipes Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 344. 1938. TYPE: Honduras. Comayagua, El Achote, above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6296* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper epilosipes Trelease var. *heterophyllum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 345. 1938. TYPE: Honduras. Comayagua, El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6097* (holotype, ILL; isotypes, F, GH, MO, NY, US).

4. Piper amalago Linnaeus, Sp. Pl. 29. 1753. TYPE: Jamaica. Sloane, Voy. Jamaica 1: 134, tab. 87, fig. 1. 1707 (lectotype, designated by Howard, 1973: 400, tab. 87, fig. 1 in Sloane, 1707).

Piper tiguanum C. DC., J. Bot. 4: 218. 1866. TYPE: Honduras. Valle, Isla del Tigre, Golfo de Fonseca, *G. W. Barclay 2633* (lectotype, designated by Nelson Sutherland, 1996: 59, K not seen).

Piper cobanense Trelease var. *sarculatum* Trelease, J. Washington Acad. Sci. 19: 331. 1929. Syn. nov. TYPE: Honduras. Yoro, Quebrada Seca, *P. C. Standley 53912* (holotype, F; isotypes, A, ILL [2], US).

Piper cobanense Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 159. 1931. Syn. nov. TYPE: Honduras. Yoro, Quebrada Seca, *P. C. Standley 53930* (lectotype, designated here, F; isotypes, ILL, US).

Piper gracillimum Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 159. 1931. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 54684* (lectotype, designated here, F; isotypes, ILL, US).

Piper wilsonii Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 161. 1931. Syn. nov. TYPE: Honduras. Atlántida, "edge of forest along trail West of Tela River, Puerto Sierra," *P. Wilson 114* (lectotype, designated here, NY; isotype, US).

Piper calvescens Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 342. 1938. Syn. nov. TYPE: Honduras. Santa Barbara, San Pedro Sula, *C. Thieme 5461* (holotype, US #796474).

Piper calvescens Trelease var. *pedunculatum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 342. 1938. TYPE: Honduras. Cortés, Potrerillos, *T. G. Yuncker 4882* (holotype, ILL; isotypes, A, F, MICH, MO, NY).

Piper calvescens Trelease var. *potrerillosense* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 343. 1938. Syn. nov. TYPE: Honduras. Cortés, Potrerillos, *T. G. Yuncker 4894* (holotype, ILL; isotypes, A, F, MICH, NY).

Piper comayaguanum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 343. 1938. Syn. nov. TYPE: Honduras. Comayagua, 6 km N of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6310* (holotype, ILL; isotypes, GH, MO, NY).

Piper deamii Trelease var. *yojoanum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 344. 1938. Syn. nov. TYPE: Honduras. Paral, Lake Yojoa, *T. G. Yuncker 4875* (holotype, ILL; isotypes, A, F, MICH, MO, NY).

Piper siguatepequense Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 354. 1938. Syn. nov. TYPE: Honduras. Comayagua, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6042* (holotype, ILL; isotypes, F, GH, MICH, MO, NY, US).

Piper siguatepequense Trelease var. *subrhombifolium* Trelease, Publ. Field. Mus. Nat. Hist. 17: 354. 1938. Syn. nov. TYPE: Honduras. Comayagua, vic. Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5617* (holotype, ILL; isotypes, F, GH, MICH, MO, NY).

Piper calvescens Trelease var. *aguanum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 278. 1940. Syn. nov. TYPE: Honduras. Yoro, Aguan River valley, below Coyoles, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8124* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper calvescens Trelease var. *cangrejalense* Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 278. 1940. Syn. nov. TYPE: Honduras. Atlántida, lower slopes of Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8464* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper gracillimum Trelease var. *dantoense* Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 279. 1940. Syn. nov. TYPE: Honduras. Atlántida, near Danto River, slopes of Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8485* (holotype, ILL; isotypes, F, GH, MICH, MO, NY [2], US).

The name *Piper tigerianum* C. DC. (1866: 300) represents only an orthographical variant (cf. McNeill et al., 2006, Art. 61.1) of *P. tiguanum*, which appeared earlier in the same publication (1866: 218). Apparently de Candolle initially misread the location of the Barclay collections as "Tigu Island" (hence the name *tiguanum*), eventually realized that the correct location was "Tiger Island," and tried to correct this with the epithet *tigerianum* as an addendum to his 1866 publication.

The lectotypes for *Piper cobanense*, *P. gracillimum*, and *P. wilsonii* were selected from F and NY material as earlier considered by Standley (1931) and seen by William Trelease.

5. Piper arboreum Aublet subsp. **arboreum**, Hist. Pl. Guiane 1: 23. 1775. TYPE: French Guiana. *J. B. C. F. Aublet s.n.* (lectotype, designated by Lanjouw & Uittien, 1940: 155, P not seen).

Piper perinaequilongum Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 160. 1931. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 56893* (lectotype, designated here, ILL; isotype, US).

Piper crassicaule Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 278. 1940. TYPE: Honduras. Atlántida, 25 km E of La Ceiba, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8572* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

The lectotype for *Piper perinaequilongum* was selected from three different collections seen by Trelease (*Standley 54419* (F, ILL), *54897* (F, ILL), and *56893* (ILL, US)). The first two collection numbers are completely sterile, whereas the third has young inflorescences, making it a more complete representation of this taxon and a better choice for lectotypification. The specimen at ILL was chosen as the lectotype because it has Trelease's handwriting, providing certainty that he actually saw this material.

6. Piper arboreum Aublet subsp. **tuberculatum** (Jacquin) Tebbs, Bull. Brit. Mus. Nat. Hist. (Bot.) 19: 156. 1989. Basionym: *Piper tuberculatum* Jacquin, Icon. Pl. Rar. 2: 2, pl. 211. 1795; Collectanea 5: 7. 1796. TYPE: Venezuela. *F. Bredemeyer s.n.* (holotype, W not seen).

Piper tuberculatum Jacquin var. *cangrejalense* Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 280. 1940. Syn. nov. TYPE: Honduras. Atlántida, lower slopes of Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8204* (holotype, ILL; isotypes, F, GH, MO, NY, US).

7. Piper augustum Rudge, Pl. Guian. 1: 10, pl. 7. 1805. TYPE: French Guiana. *J. Martin s.n.* (holotype, BM not seen).

The introductory comments by Stearn and Williams (1957) describe in detail the fate of Joseph Martin's collections after the French ship on which he was traveling was captured by British privateers. The specimens ultimately were purchased by Edward Rudge and Alymer Lambert, and the British Museum eventually acquired them in the 1840s, where they now reside. Rudge described 50 new species on the basis of Martin's collections, including four for *Piper* and one in *Peperomia* Ruiz & Pavón.

8. Piper auritum Kunth, Nov. Gen. Sp. 1: 54. 1816. TYPE: Mexico. Veracruz, "Crescit in regni Novae Hispaniae temperatis," *F. W. H. A. Humboldt s.n.* (holotype, P not seen; isotype, IDC 6209: 6.3).

Piper auritilaminum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 277. 1940. TYPE: Honduras. Atlántida, vicinity of La Ceiba, Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8263* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper auritilimbum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 277. 1940. TYPE: Honduras. Atlántida, Río Danto, slopes of Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8763* (holotype, ILL; isotypes, GH, MO, NY [2], US).

9. Piper biauritum C. DC., Anal. Inst. Fis.-Geog. Costa Rica 9: 161. 1897. TYPE: Costa Rica. Forest of Xirores, Talamanca, 100 m, *A. Tonduz 9270* (holotype, G not seen; isotype, US not seen).

10. Piper bisasperatum Trelease, Contr. U.S. Natl. Herb. 26: 173. 1929. TYPE: Costa Rica. Cartago, Cerro de la Carpintera, 1500–1850 m, *P. C. Standley 35723* (holotype, US not seen).

11. Piper bredemeyeri J. Jacquin, Ecl. Pl. Rar. 1: 125, pl. 84. 1816. TYPE: Venezuela. Caracas, *F. Bredemeyer s.n.* (holotype, W not seen).

Piper alveolatifolium Trelease, J. Washington Acad. Sci. 19: 329. 1929. TYPE: Honduras. Comayagua, Siguatepeque, *P. C. Standley 56344* (holotype, F; isotypes, A, ILL, US).

Piper faviculiferum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 345, t. 11. 1938. Syn. nov. TYPE: Honduras. Comayagua, El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6368* (holotype, ILL; isotypes, GH, MO, NY).

12. Piper chamissonis (Miquel) Steudel, Nomencl. Bot, ed. 2, 2: 340. 1841, nomen; ex C. DC., in A. DC., Prodr. 16(1): 283. 1869. Basionym: *Artanthe chamissonis* Miquel, Syst. Piperac. 457. 1844. TYPE: Mexico. Veracruz, "prope Hacienda de la Laguna," *C. J. W. Scheide s.n.* (lectotype, designated by Tebbs [as holotype], 1993: 36, B not seen).

13. Piper chrysostachyum C. DC., Bull. Soc. Roy. Bot. Belgique 30(1): 207. 1891. TYPE: Costa Rica. Near San Mateo, *H. F. Pittier 4073* (holotype, G not seen).

14. Piper colonense C. DC., Smithsonian Misc. Collect. 71(6): 11. 1920. TYPE: Panama. Colón, Río Fato valley, *H. F. Pittier 4221* (holotype, US not seen; isotypes, BM, GH not seen, NY).

Piper puente-altoanum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 280. 1940. Syn. nov. TYPE: Honduras. Atlántida, mountain slope near Puente Alto stop on S.F. Company railroad, East of La Ceiba, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8549* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

15. Piper crassinervium Kunth, Nov. Gen. Sp. 1: 48. 1816. TYPE: Colombia. "Crescit regime calidissima, in umbrosis, ad ripas fluminis Magdalenae, prope Honda," *F. W. H. A. Humboldt 377* (holotype, P not seen; isotype, IDC 6209: 5.5).

16. Piper fallens Trelease, J. Washington Acad. Sci. 19: 332. 1929. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 53968* (holotype, F; isotypes, A, ILL, US).

17. Piper glabrescens (Miquel) C. DC., in A. DC., Prodr. 16(1): 271. 1869. Basionym: *Artanthe glabrescens* Miquel, London J. Bot. 4: 461. 1845. TYPE: Guyana. *Parker s.n.* (holotype, K not seen).

Piper yzabalanum C. DC. var. *pubinerve* Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 161. 1931. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 55776* (lectotype, designated here, F; isotype, ILL).

The lectotype for *Piper yzabalanum* var. *pubinerve* was selected from F material as earlier considered by Standley (1931) and seen by William Trelease.

18. Piper grande Vahl, Eclog. Amer. 2: 3, pl. 11. 1798. TYPE: Colombia. Santa Martha, *J. P. B. von Rohr 46* (holotype, C not seen; isotypes, IDC 2201: 54.12 and 55.1–2).

19. Piper hispidum Swartz, Prodr. 15. 1788. TYPE: Jamaica, *O. P. Swartz s.n.* (holotype, M not seen).

Piper aspericaule Trelease, J. Washington Acad. Sci. 19: 329. 1929. Syn. nov. TYPE: Honduras. Atlántida, vic. Tela, *P. C. Standley 55125* (holotype, F; isotypes, A, ILL, US).

Piper fraguanum Trelease, J. Washington Acad. Sci. 19: 332. 1929. TYPE: Honduras. Atlántida, La Fragua, *P. C. Standley 55730* (holotype, F; isotypes, ILL, US).

Piper hispidiseptum Trelease, J. Washington Acad. Sci. 19: 332. 1929. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 52715* (holotype, F; isotypes, A, ILL, US).

Piper imperspicuibracteum Trelease, J. Washington Acad. Sci. 19: 332. 1929. Syn. nov. TYPE: Honduras. Atlántida, vic. Tela, *P. C. Standley 54770* (holotype, F; isotypes, A, ILL, US).

Piper lancetillanum Trelease, J. Washington Acad. Sci. 19: 333. 1929. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 56552* (holotype, F; isotypes, A, ILL, US).

Piper obsessum Trelease, J. Washington Acad. Sci. 19: 334. 1929. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 54925* (holotype, F; isotypes, A, ILL, US).

Piper perspicuibracteum Trelease, J. Washington Acad. Sci. 19: 335. 1929. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 54872* (holotype, F; isotypes, A, ILL, US).

Piper prodigum Trelease, J. Washington Acad. Sci. 19: 335. 1929. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 54916* (holotype, F; isotypes, A, ILL, US).

Piper scabriseptum Trelease, J. Washington Acad. Sci. 19: 336. 1929. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley, near Tela, *P. C. Standley 52681* (holotype, F; isotypes, A, ILL, US).

Piper speratum Trelease, J. Washington Acad. Sci. 19: 336. 1929. Syn. nov. TYPE: Honduras. Atlántida, near Tela, *P. C. Standley 55184* (holotype, F; isotypes, A, ILL, US).

Piper yoroanum Trelease, J. Washington Acad. Sci. 19: 337. 1929. Syn. nov. TYPE: Honduras. Yoro, Quebrada Seca, *P. C. Standley 53889* (holotype, F; isotypes, A, ILL, US).

Piper adornatispicum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 340. 1938. Syn. nov. TYPE: Honduras. Comayagua, wet ravine at El Achote, above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5885* (holotype, ILL; isotypes, F, GH, MO).

Piper apertum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 341. 1938. Syn. nov. TYPE: Honduras. Cortés, near shore of Lake Yojoa, *T. G. Yuncker 4821* (holotype, ILL; isotypes, F, NY).

Piper apertum Trelease var. *nodosum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 341. 1938. Syn. nov. TYPE: Honduras. Cortés, near shore of Lake Yojoa, *T. G. Yuncker 4821a* (holotype, ILL).

Piper fraguanum Trelease var. *viride* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 346. 1938. TYPE: Honduras. Atlántida, near Lancetilla, *T. G. Yuncker 4918* (holotype, ILL; isotypes, A, F, MO, NY).

Piper scabriseptum Trelease var. *reductum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 353. 1938. Syn. nov. TYPE: Honduras. Atlántida, near Lancetilla, *T. G. Yuncker 4773* (holotype, ILL; isotypes, A, F, NY).

Piper roseovenulosum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 353. 1938. Syn. nov. TYPE: Honduras. Cortés, near Parál, shore of Lake Yojoa, *T. G. Yuncker 4873* (holotype, ILL; isotypes, A, F, MO, NY).

Piper tenuiculispicum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 354. 1938. Syn. nov. TYPE: Honduras. Atlántida, bank of Tela River, above Lancetilla, *T. G. Yuncker 4509* (holotype, ILL; isotype, NY).

Piper meritum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 279. 1940. TYPE: Honduras. Atlántida, La Ceiba, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8363* (holotype, ILL; isotypes, GH, MO, NY [2], US).

20. Piper imberbe Trelease & Standley, Fieldiana Bot. 24: 303. 1952. TYPE: Guatemala. Izabal, between Escobas and waterfall, *P. C. Standley 39857* (holotype, F).

21. Piper jacquemontianum Kunth, Linnaea 13: 631. 1839. TYPE: Dominican Republic, *V. V. Jacquemont s.n.* (holotype, B not seen).

Piper aeruginosibaccum Trelease, J. Washington Acad. Sci. 19: 328. 1929. TYPE: Honduras. Atlántida, near La Ceiba, *P. C. Standley 56735* (holotype, F; isotypes, A, ILL, US).

Piper deditítium Trelease, J. Washington Acad. Sci. 19: 331. 1929. TYPE: Honduras. Yoro, Quebrada Seca, *P. C. Standley 53937* (holotype, F; isotypes, A, ILL, US).

Piper onerosum Trelease, J. Washington Acad. Sci. 19: 335. 1929. TYPE: Honduras. Atlántida, Tela, *P. C. Standley 53696* (holotype, F; isotypes, A, ILL, US).

Piper praeterlatum Trelease, J. Washington Acad. Sci. 19: 335. 1929. TYPE: Honduras. Atlántida, Lancetilla Valley near Tela, *P. C. Standley 54337* (holotype, F; isotypes, A, ILL, US).

Piper rexans Trelease, J. Washington Acad. Sci. 19: 336. 1929. TYPE: Honduras. Atlántida, near Tela, *P. C. Standley 54742* (holotype, F; isotypes, A, ILL, US).

Piper triumphale Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 161. 1931. Syn. nov. TYPE: Honduras. Atlántida, vic. Tela, thicket along beach, *P. C. Standley 53035* (lectotype, designated here, F; isotype, ILL).

Piper actae Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 340. 1938. Syn. nov. TYPE: Honduras. Atlántida, in sandy soil along beach, Tela, *T. G. Yuncker 4657* (holotype, ILL; isotypes, A, F, MO, NY).

Piper allatum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 341. 1938. Syn. nov. TYPE: Honduras. Comayagua, El Rincon, 10 mi. W of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6068* (holotype, ILL; isotype, GH).

Piper arenicola Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 341. 1938. Syn. nov. TYPE: Honduras. Atlántida, between Tela and Lancetilla, *T. G. Yuncker 4499* (holotype, ILL; isotypes, A, F, NY).

Piper paludicola Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 351. 1938. Syn. nov. TYPE: Honduras. Atlántida, marshy area near Tela, *T. G. Yuncker 4977* (holotype, ILL; isotypes, A, F, MO, NY).

Piper evulsipilosum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 279. 1940. TYPE: Honduras. Atlántida, La Ceiba, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8015* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper sagax Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 280. 1940. Syn. nov. TYPE: Honduras. Yoro, Coyoles, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8030* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper tumidipedunculum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 281. 1940. TYPE: Honduras. Yoro, Las Flores, near Coyoles, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8151* (holotype, ILL; isotypes, GH, MO, NY [2], US).

The lectotype for *Piper triumphale* was selected from F material as earlier considered by Standley (1931) and seen by William Trelease.

22. Piper lacunosum Kunth, Nov. Gen. Sp. 1: 51. 1816. TYPE: Brazil. "Crescit in montanis, temperatis Provinciae Jaen de Bracamoros, inter Passo de Matara et Cavico," *F. W. H. A. Humboldt s.n.* (holotype, P not seen; isotype, IDC 6209: 5.16).

23. Piper marginatum Jacquin, Icon. Pl. Rar. 2: 2, pl. 215. 1795. TYPE: Plumier, Descr. Pl. Amér. tab. 76. 1693 (lectotype, designated by Saralegui Boza, 2004: 68, tab. 76 in Plumier, 1693).

Piper quiriguanum Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 160. 1931. TYPE: Honduras. Yoro, near Progreso, *P. C. Standley 54995* (lectotype, designated by Jones, 1985: 75, ILL; isotypes, A, F).

24. Piper martensianum C. DC., in A. DC., Prodr. 16(1): 251. 1869. TYPE: Mexico, *J. A. Pavón s.n.* (holotype, G not seen; photo of holotype at A, F, MO, neg. 34144).

25. Piper obliquum Ruiz & Pavón, Fl. Peruv. 1: 37, pl. 63. 1798. TYPE: Peru. "in Cuchero sylvis ad Cayumba terminum," *H. Ruiz López & J. A. Pavón s.n.* (holotype, P not seen; isotype, BM not seen).

Piper laterifissum Trelease, J. Washington Acad. Sci. 19: 333. 1929. TYPE: Honduras. Atlántida, Lancetilla Valley near Tela, *P. C. Standley 53943* (holotype, F; isotypes, A, ILL, US).

Piper auritum Kunth f. *rinconense* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 342. 1938. Syn. nov. TYPE: Honduras. Comayagua, El Rincon, Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6064* (holotype, ILL; isotypes, GH, MO).

Piper cristicola Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 343. 1938. Syn. nov. TYPE: Honduras. Comayagua, El Achote, above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6247* (holotype, ILL; isotype, GH).

26. Piper peltatum L., Sp. Pl. 1: 30. 1753. TYPE: Plumier, Descr. Pl. Amér., tab. 74. 1693 (lectotype, designated by Howard, 1973: 381, tab. 74 in Plumier, 1693).

27. Piper peracuminatum C. DC., Smiths. Misc. Coll. 71(6): 9. 1920. TYPE: Panama. Colón, Dos Bocas, Río Fató valley, *H. F. Pittier 4210* (holotype, US 679313; isotype, G not seen).

28. Piper perhispidum C. DC., Bot. Gaz. 70: 183. 1920. TYPE: Costa Rica. Bords du Río Barranca, near San Juan de San Ramón, *A. Tonduz 17771* (holotype, G not seen).

29. Piper phytolaccifolium Opiz in Presl, Reliq. Haenk. 151. 1828. TYPE: Ecuador. Guayaquil, *T. P. X. Haenke s.n.* (holotype, PR not seen).

Piper telanum Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 161. 1931. Syn. nov. TYPE: Honduras. Atlántida, forest W of Tela River, 29 Jan. 1903, *P. Wilson 222* (lectotype, designated here, NY; isotypes, F, ILL [lectotype fragment]).

For *Piper telanum*, the specimen at F is without a collection number, but other identifying information

(e.g., collection date, locality, and Trelease's handwriting) is the same as the specimen at NY. The specimen at NY has Trelease's handwriting and initials in the lower left corner, with his designation of "Type" clearly indicated.

30. Piper pseudoasperifolium C. DC., in A. DC., Prodr. 16(1): 318. 1869. TYPE: Mexico. Oaxaca, *P. E. Boissier s.n.* (holotype, G not seen).

Piper indignum Trelease, J. Washington Acad. Sci. 19: 333. 1929. TYPE: Honduras. Comayagua, near Siguatepeque, *P. C. Standley 55990* (holotype, F; isotypes, A, ILL, US).

31. Piper pseudofuligineum C. DC., Linnaea 37: 355. 1872. TYPE: Costa Rica. Monte Candelaria, *A. S. Oersted s.n.* (holotype, C not seen).

Piper atlantidanum Trelease, J. Washington Acad. Sci. 19: 329. 1929. TYPE: Honduras. Atlántida, near La Ceiba, *P. C. Standley 56739* (holotype, F; isotypes, A, ILL, US).

Piper atlantidanum Trelease var. *yoroense* Trelease, J. Washington Acad. Sci. 19: 330. 1929. Syn. nov. TYPE: Honduras. Yoro, near Progreso, *P. C. Standley 55073* (holotype, F; isotypes, A, ILL, US).

Piper deltoideocarpum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 344. 1938. TYPE: Honduras. Comayagua, riverbank near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5654* (holotype, ILL; isotypes, F, GH, MO, US).

Piper ornatispicum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 351. 1938. Syn. nov. TYPE: Honduras. Comayagua, thicket on riverbank near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5618* (holotype, ILL; isotypes, GH, MO, NY).

Piper praemollitum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 352. 1938. Syn. nov. TYPE: Honduras. Cortés, near shore of Lake Yojoa, *T. G. Yuncker 4825* (holotype, ILL; isotypes, A, MO, NY).

Piper tesseraespicum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 354. 1938. TYPE: Honduras. Comayagua, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5662* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper viae-marginis Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 355. 1938. Syn. nov. TYPE: Honduras. Comayagua, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6044* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper coyolesense Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 278. 1940. TYPE: Honduras. Yoro, near Las Flores, Río Aguán, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8147* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper elasmophyllum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 278. 1940. TYPE: Honduras. Atlántida, lower slopes of Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8461* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

Piper subaequilaterum Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 280. 1940. TYPE: Honduras. Atlántida, Roma siding, about 25 km E of La Ceiba, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8565* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

32. Piper pseudolindenii C. DC., Linnaea 37: 335. 1872. TYPE: Costa Rica. "ad Realgo," *A. S. Oersted s.n.* (holotype, C not seen).

Piper firmifolium Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 346. 1938. Syn. nov. TYPE: Honduras. Comayagua, near El Rincón, ca. 10 mi. W of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6048* (lectotype, designated by Jones, 1985: 38, ILL; isotypes, F, GH, ILL, MICH, MO, NY).

Piper laceratibracteum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 346. 1938. Syn. nov. TYPE: Honduras. Comayagua, ravine at El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6266* (holotype, ILL; isotypes, F, GH, MICH, MO).

Piper koepperi Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 279. 1940. Syn. nov. TYPE: Honduras. Yoro, Aguán Valley, near Medina, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8631* (holotype, ILL; isotypes, F, GH, MICH, MO, NY [2], US).

Piper clivicola P. C. Standley & L. O. Williams, Ceiba 1: 142. 1950. Syn. nov. TYPE: Honduras. Intibucá, vic. La Esperanza and Intibucá, *P. C. Standley 25627* (holotype, EAP not seen; isotypes, F, US).

Jones (1985) designated a lectotype for *Piper firmifolium* Trelease because there are two collections at ILL of *Yuncker et al. 6048*, both with "Type" written on the label in Trelease's handwriting. She did not offer any explanation for choosing one specimen over the other, but there are appropriate annotation labels to clearly distinguish between them.

33. Piper reticulatum L., Sp. Pl. 1: 29. 1753. TYPE: Martinique. Plumier, Descr. Pl. Amér., tab. 75. 1693 (lectotype, designated by Howard, 1988: 29, tab. 75 in Plumier, 1693).

34. Piper sanctum (Miquel) Schlechtendal ex C. DC., in A. DC., Prodr. 16(1): 330. 1869. Basionym: *Artanthe sancta* Schlechtendal ex Miquel, Linnaea 18: 714. 1844. TYPE: Mexico. Atlacomulco, *C. J. W. Schiede 1105* (holotype, HAL not seen).

35. Piper scalarispicum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 353. 1938. TYPE: Honduras. Comayagua: above El Achote, SW of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6156* (holotype, ILL; isotypes, F, GH, MO, NY, US).

Piper nubigaudens Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 351. 1938. TYPE: Honduras. Comayagua, above El Achote, near Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5991* (holotype, ILL; isotypes, F, GH, MO, US).

36. Piper schiedeanum Steudel, Nomencl. Bot. ed. 2, 2: 343. 1841. Replaced Name: *Piper tiliifolium* Schlechtendal & Chamisso, Linnaea 6: 352. 1831, non *Piper tiliifolium* Desvaux ex Hamilton, lit. cit. 1825. TYPE: Mexico. "in sylvis Misantlae," *C. J. W. Schiede 1102* (holotype, BM not seen).

Piper levilimbum Trelease, J. Washington Acad. Sci. 19: 333. 1929. TYPE: Honduras. Atlántida, Lancetilla Valley near Tela, *P. C. Standley 53483* (holotype, F; isotypes, A, ILL, US).

Piper cyclophyllum Trelease, Field Mus. Nat. Hist., Bot. Ser. 10: 159. 1931. Syn. nov. TYPE: Honduras. Atlántida, Lancetilla Valley near Tela, *P. C. Standley 52703* (lectotype, designated here, F; isotype, ILL).

Piper atrichopus Trelease var. *arborescens* Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 276. 1940. TYPE: Honduras. Atlántida, ca. 25 km E of La Ceiba, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8578* (holotype, ILL; isotypes, F, MO, NY).

Piper exigens Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 345. 1938. TYPE: Honduras. Comayagua, El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6124* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper exigens Trelease var. *subovatum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 345. 1938. TYPE: Honduras. Comayagua, El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5997* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper variabile C. DC. ex J. Donnell Smith var. *obtentum* Trelease, Field Mus. Nat. Hist., Bot. Ser. 9: 281. 1940. TYPE: Honduras. Atlántida, near La Ceiba, Mt. Cangrejal, *T. G. Yuncker, J. M. Koepper & K. A. Wagner 8495* (holotype, ILL; isotypes, F, GH, MO, NY [2], US).

The lectotype for *Piper cyclophyllum* was selected from F material as earlier considered by Standley (1931) and seen by William Trelease.

37. Piper trigonum C. DC., J. Bot. 4: 212. 1866. TYPE: Colombia. Barbacoas, *J. J. Triana 44* (holotype, G not seen; isotype, BM not seen).

38. Piper tuerckheimii C. DC. ex J. Donnell Smith, Bot. Gaz. 19: 258. 1894. TYPE: Guatemala. Alta Verapaz, Pansamalá, *H. Tuerckheim 1038* (holotype, US 798221).

39. Piper umbellatum L., Sp. Pl. 30. 1753. TYPE: Plumier, Descr. Pl. Amér., tab. 73. 1693 (lectotype, designated by Huber, 1987: 289, tab. 73 in Plumier, 1693).

40. Piper umbricola C. DC., Bull. Soc. Roy. Bot. Belgique 30(1): 215. 1891. TYPE: Costa Rica. "Bois frais près du Rodeo de Pacaca, flor en janvier," *H. F. Pittier 3238* (lectotype, designated by Tebbs [as holotype], 1993: 31, G not seen; isotype, US 798345).

Piper inconsumptum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 346. 1938. Syn. nov. TYPE: Honduras. Cortés, near Paral, Lake Yojoa, *T. G. Yuncker 4871* (holotype, ILL; isotypes, A, F, MO, NY).

41. Piper urophyllum C. DC., Anal. Inst. Fis.-Geog. Costa Rica 9: 170. 1897. TYPE: Costa Rica. "Bois dans la vallée du Rio Tuis (basin du Reventazón), 600 m," *H. Pittier 8159* (lectotype, designated by Tebbs [as holotype], 1990: 204, G not seen).

42. Piper veraguense C. DC., in A. DC., Prodr. 16(1): 294. 1869. TYPE: Costa Rica. Veragua, *J. Warszewicz s.n.* (holotype, G not seen).

43. Piper villiramulum C. DC., Smiths. Misc. Coll. 71: 11. 1920. TYPE: Panama. Colón, Loma de la Gloria, near Fató, *H. F. Pittier 4083* (holotype, US 679179; isotype, NY).

Piper dawsoni Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 343. 1938. Syn. nov. TYPE: Honduras. Comayagua, El Achote, above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6283* (holotype, ILL; isotypes, F, GH, MO, NY).

Piper laedans Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 347. 1938. Syn. nov. TYPE: Honduras. Comayagua, El Achote, above Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 5821* (holotype, ILL; isotypes, GH, MO, NY).

Piper mystaciferum Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 350. 1938. Syn. nov. TYPE: Honduras. Comayagua, ravine at El Rincón, 10 miles W of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6054* (holotype, ILL; isotypes, F, GH, MO, US).

44. Piper xanthostachyum C. DC., Anal. Inst. Fis.-Geog. Costa Rica 9: 169. 1897. TYPE: Costa Rica. "Bois de la vallée du Rio Tuis," *H. F. Pittier 8158* (lectotype, designated by Tebbs [as holotype], 1990: 227, G not seen).

Piper monteluctans Trelease, Field Mus. Nat. Hist., Bot. Ser. 17: 347. 1938. Syn. nov. TYPE: Honduras. Comayagua, ridge above El Achote, in cloud zone, above plains of Siguatepeque, *T. G. Yuncker, R. F. Dawson & H. R. Youse 6176* (holotype, ILL; isotypes, F, GH, MO).

45. Piper yucatanense C. DC., Linnaea 37: 334. 1872. TYPE: Mexico. Yucatán, *J. J. Linden 184* (holotype, G-DEL).

Piper thiemeanum Trelease, Amer. J. Bot. 8: 214, pl. 5, fig. 2. 1921. TYPE: Honduras. Cortes, San Pedro Sula, *C. Thieme 5455* (holotype, US 796492; isotypes, GH, K, UC, US [3]).

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Two New Species in the Genus *Poikilogyne* (Melastomataceae) from Papua New Guinea

Nicoletta Cellinese

Botany Division, Peabody Museum of Natural History, Yale University, 170 Whitney Avenue, New Haven, Connecticut 06520-8118, U.S.A. nico.cellinese@yale.edu

Abstract. Two new species, *Poikilogyne cornuta* Cellinese & J. F. Maxwell and *P. lakekamuensis* Cellinese, are here described. *Poikilogyne cornuta* is distinct in the genus for the dimorphic anthers and for the peculiar disparity of the connectives and locules. *Poikilogyne lakekamuensis* is the only vine in the genus having 4-merous flowers. Both species are endemic to Papua New Guinea and known only from a single locality.

Key words: Melastomataceae, Papua New Guinea, *Poikilogyne*.

The Melastomataceae are a large, pantropical family of 150 to 166 genera and about 4570 species (Renner, 1993). The family is most diverse in the Neotropics, and around one third of the known species occur in the Paleotropics. The genus *Poikilogyne* Baker f. belongs to the tribe Sonerileae, first established by Triana (1865). The tribe included mainly herbaceous species from the Old World, whereas shrubby species were part of the tribe Oxysporeae (Triana, 1865). Triana also established the tribe Bertolonieae to include all of the New World taxa. Recent phylogenies of the family based on *rbcL*, *ndhF*, and *rpl16* sequences (Clausing & Renner, 2001) suggest that the Old World Sonerileae form a natural group, but do not support the monophyly of the Oxysporeae sensu Triana. The New World Bertolonieae are sister to a larger clade that includes the Sonerileae, Dissochaeteae, Blakeeae, Melastomeae, Rhexieae, and Microlicieae.

Poikilogyne comprises 21 species, and its distribution is entirely Melanesian, mainly represented in New Guinea, and occasionally to the east in the D'Entrecasteaux Islands, New Britain, and the Solomon Islands (Cellinese & Maxwell, in prep.). Collections are not numerous, perhaps due to undercollecting. Therefore, the details of its geographic distribution remain to be learned.

Most species belonging to the genus *Poikilogyne* are shrubs or treelets 1–7 m tall, rarely vines, with terminal, multiflorous inflorescences and spreading branches. Usually, leaf blades are ovate to more or less orbicular, with acute apex, a rounded to cordate base, and serrulate to serrate margins. The main veins are basal, often 1 to 5 pairs with a thinner, outermost (intramarginal) pair, and the secondary and tertiary veins are distinctly reticulate. The flowers are 5-merous, but in a few species they are 4-merous, most often with a winged or ribbed campanulate hypanthium. The stamens are typically similar, having straight or slightly curved anthers with acute to obtuse tips, a very small terminal pore, a prominently thickened connective as thick or thicker than the thecae, and a thickened, obtuse basal spur (usually 0.75–1 mm long). Fruits are capsular, but fruiting specimens are not available for 7 of the 21 known species in *Poikilogyne*.

The characters that set *Poikilogyne cornuta* Cellinese & J. F. Maxwell apart include the axillary, cymose, 3-flowered inflorescences, 4-merous flowers, and dimorphic stamens. The connective of the anthers does not completely cover the locules in the upper quarter, while the lower quarter lacks locules; antepetalous and antesepalous anthers have spurs of a somewhat different form. *Poikilogyne cornuta* is the only species of the genus with dimorphic anthers and with the peculiar disparity of the connectives and locules.

Poikilogyne lakekamuensis Cellinese represents one of four species in the genus having 4-merous flowers. Within this group it is distinguished by its climbing habit and small, equal, ovate to suborbicular leaves.

Poikilogyne cornuta Cellinese & J. F. Maxwell, sp. nov. TYPE: Papua New Guinea. Above Bakaia, ca. 15 mi. SE of Garaina, Morobe district, 8 Feb. 1964, *T. G. Hartley 12882* (holotype, A; isotypes, CANB, L). Figure 1.

Haec species a congeneris antheris dimorphis antepetalarum calcaribus ellipticis, antesepalarum calcaribus ligulatis, omnibus connectivo in quarta suprema loculos non omnino tegente et in quarta infima loculis carentibus distinguitur.

Small tree to 3 m high, branchlets obscurely quadrangular to compressed, 2-grooved, becoming cylindric, sparsely and minutely grayish farinose but

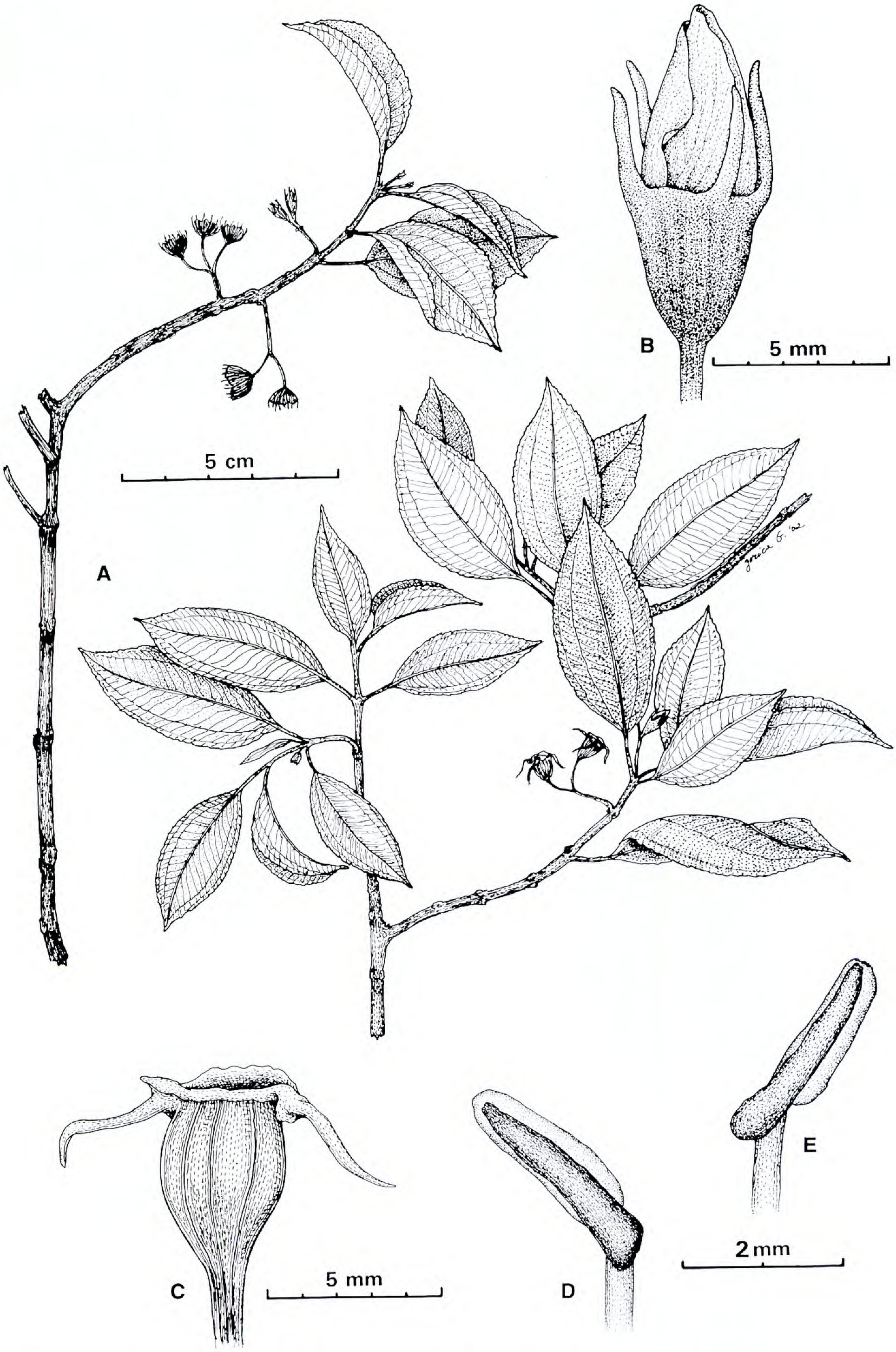

Figure 1. *Poikilogyne cornuta* Cellinese & J. F. Maxwell. —A. Habit. —B. Flower. —C. Fruit. —D. Antesepalous anther. —E. Antepetalous anther. Based on the holotype *T. G. Hartley 12882* (A).

glabrous and rugose when mature, about 2 mm thick. Leaves elliptic to oblong, 4.2–7.5 × 2–3.4 cm, membranaceous, basal veins 1 pair, plus a thin intramarginal pair, adaxial surface glabrous to sparsely farinose, medium green, drying dull blackish and minutely papillose, abaxial surface with dispersed farinose indument, the midrib often with sparse rigid setae, drying gray-brown, base acute, apex acuminate, margin serrulate; petioles with evanescent indument, 0.8–2.2 cm. Inflorescence axillary, cymose, 3-flow-

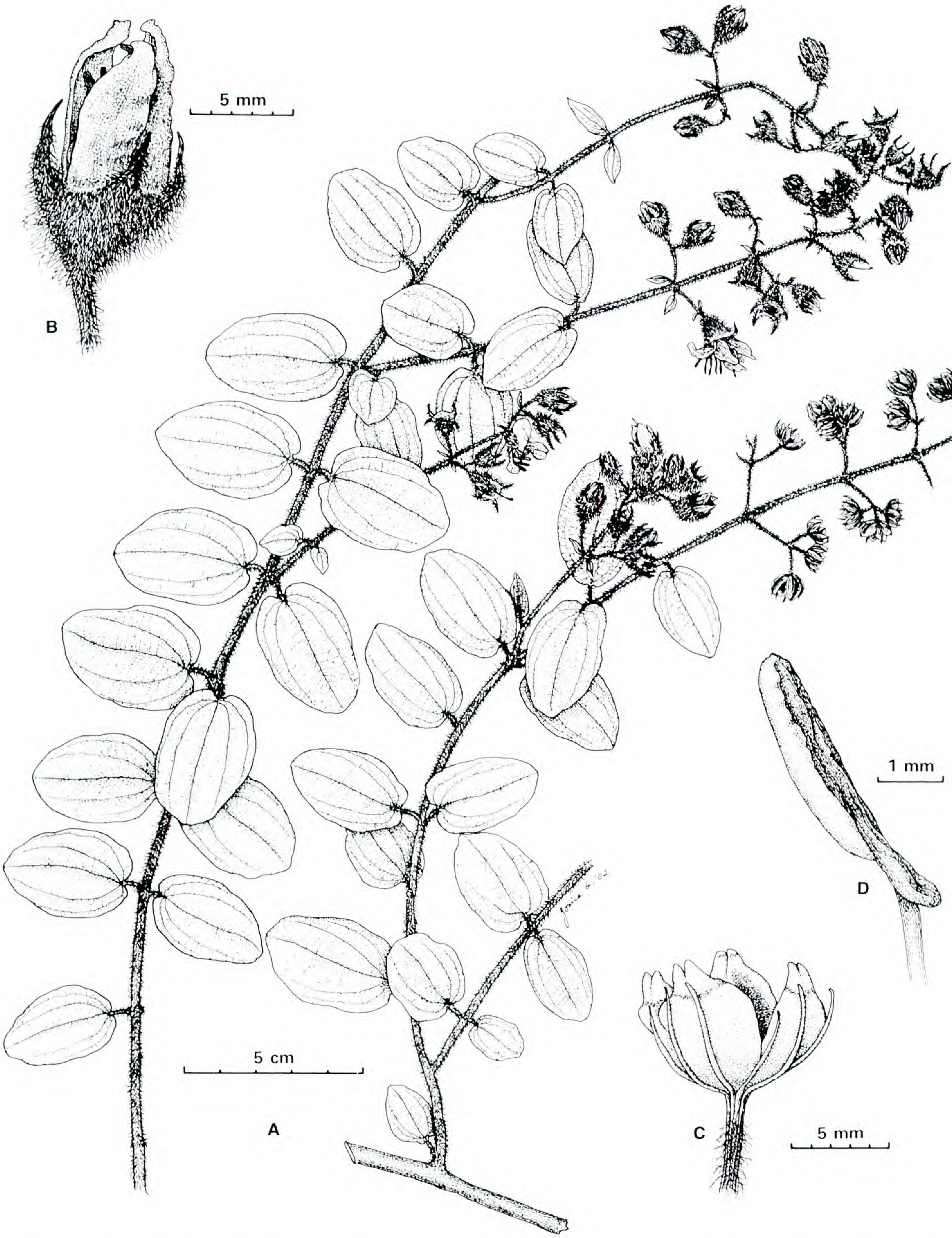

Figure 2. *Poikilogyne lakekamuensis* Cellinese. —A. Habit. —B. Flower. —C. Old fruit. —D. Stamen. Based on the holotype *W. Takeuchi & J. Kulang 11396* (BRIT).

ered, axes quadrangular to compressed, sparsely farinose; primary axis 8–10 mm; bracts and bracteoles not seen. Flowers 4-merous, pedicels 2.5 mm; hypanthium cyathiform, slightly wider at the apex, ca. 5 × 2.5 mm, thin, sparsely farinose, greenish pink; sepals 5 mm, thin, curved, laterally compressed from below the margin; petals asymmetric, 8 × 5 mm, elliptic, obtuse, cusp slightly eccentric, base truncate, deep pink; stamens 8, dimorphic, filaments 3 mm, antepetalous anthers ca. 3 mm, linear, rounded, dorsal elliptic spurs 1 mm, antesepalous anthers about 3 mm, linear, rounded, narrower with ligulate dorsal spurs 1 mm, connective along lower 3/4 of the dorsal surface, locules on the upper 3/4 of the ventral

surface; ovary conic, grooved at apex; style 6 mm. Fruit a capsule, subglobose to urceolate, 10-ridged, 3.5–5 × 3.5–5 mm, old fruit wall disintegrating after dehiscence and seed dispersal; seeds not seen.

Distribution and habitat. This species is endemic to Papua New Guinea and is known from the type collection only. It is found in upper montane rain forest at 2170 m altitude.

Etymology. The specific epithet refers to the distinct shape of the anther spurs.

Poikilogyne lakekamuensis Cellinese, sp. nov. TYPE: Papua New Guinea. Gulf Prov.: Lakekamu, E branch of Avi Avi River, ridge line past proposed research station, at jct. of foot-track with 2nd ridge, 22 Oct. 1996, *W. Takeuchi & J. Kulang 11396* (holotype, BRIT; isotypes, A, CANB, NY). Figure 2.

Haec species a congeneris 4-meris habitu scandente atque foliis parvis aequalibus ovatis usque suborbicularibus distinguitur.

Vine, branchlets and twigs terete, densely covered with pale, spreading, capitate and glandular hairs to 4 mm. Leaves in a pair, equal, 2–4.5 × 1.3–3 cm, ovate to suborbicular, midrib with 2 or 3 pairs of basal veins, adaxial surface somewhat rugose, glabrescent, dark dull green, abaxial surface light green, sparsely setose, especially along veins, base cordate, apex rounded, margin entire, with scattered hairs; petioles with indument as on branchlets, 3–5 mm. Inflorescence terminal, paniculate, 10–13 cm, axes terete, with an indument as on branchlets; bracts and bracteoles subulate to lanceolate, 1–4 mm. Flowers 4-merous, pedicels 3–8 mm, with glutinous setiferous hairs; hypanthium campanulate to urceolate, 5–6 × 4 mm, densely covered with setiferous, often gland-tipped hairs, white; sepals linear, ca. 5 mm, with an indument as on the hypanthium; petals cruciform, 7–8 × 4 mm, pink; stamens 8, secund, filaments flat, ca. 4 mm, white, anthers 3.5–4.5 mm, yellow, dorsal spur ca. 1 mm; ovary about one third as long as the hypanthium, apex smooth and rounded; style arcuate, ca. 10 mm, mostly pink. Capsules subglobose to urceolate, ca. 6 × 5 mm, sparsely setose, brown, sepals persistent, old fruit wall disintegrating after dehiscence and seed dispersal; seeds cuneate, ca. 1 mm, variously elongate, papillose, light brown.

Distribution and habitat. This species is endemic to Papua New Guinea and described from the type collection only. It is found in natural-growth foothill forest at 183 m altitude.

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Name Changes for Chinese *Pilea* (Urticaceae)

Chia-Jui Chen (Chen Jia-rui)
Institute of Botany, Chinese Academy of Sciences, Xiangshan, Beijing 100093, People's Republic of China

Alex K. Monro
Department of Botany, The Natural History Museum, London SW7 5BD, United Kingdom.
a.monro@nhm.ac.uk

Lian Chen
Panzhihua Institute of Horticulture, Panzhihua, Sichuan 617000, People's Republic of China

Abstract. Two new names in *Pilea* Lindley from China are published: *Pilea panzhihuaensis* C. J. Chen, A. K. Monro & L. Chen and *P. spicata* C. J. Chen & A. K. Monro. A lectotype is designated for the basionym of *P. spicata*, *Smithiella myriantha* Dunn. The origins of the new names are explained, synonymy of the resurrected name is given, and an illustration of *P. panzhihuaensis* is provided.

Key words: China, Flora of China, *Pilea*, *Podophyllum*, Urticaceae.

Pilea Lindley, with over 700 species (Monro, 2005), is the largest genus in the Urticaceae and one of the larger genera in the Urticalean Rosids. It is distributed throughout the tropics, subtropics, and temperate regions (with the exception of Australia and New Zealand). *Pilea* can be easily distinguished from most other Urticaceae by the opposite leaves (with very rare exceptions), in combination with a single ligulate intrapetiolar stipule in each leaf axil and both male and female flowers borne on branching inflorescences. The genus was last monographed by Weddell (1869). Since that time, the majority of taxonomic contributions have come from Flora treatments (Monro, 2005). *Pilea* in China was last revised by Chen (1982, 1995) and Chen and Monro (2003), at which time 80 species were recognized. Since the latter treatment, collections from southwestern Sichuan and the recognition that two previously accepted names are later homonyms have necessitated the creation of two new names and the resurrection of a third name.

Pilea panzhihuaensis C. J. Chen, A. K. Monro & L. Chen, nom. nov. Replaced name: *Podophyllum cavaleriei* H. Léveillé, Bull. Acad. Geogr. Bot. 24: 142. 1914, non *Pilea cavaleriei* H. Léveillé, Repert. Spec. Nov. Regni Veg. 11: 65. 1912.

TYPE: China. Guizhou: Zhenning (Kchen-lin), shady, rocks, Dec. 1911, *J. Cavalerie 3937* (holotype, P; isotype, E). Figure 1.

Herbs perennial, rhizomatous and stoloniferous, glabrous, dioecious, sometimes monoecious; stems somewhat succulent, green, simple, erect, sometimes climbing, 50–150 × 1–2 cm, internodes 2–5 cm, smooth. Leaves decussate (opposite), deciduous on the basal half of the stems; leaf scars conspicuous, ± orbicular, 7–10 mm diam.; stipules large, squamose, persistent distally, light green, broadly ovate, 15–20 × 12–17 mm, with margin somewhat reflexed, and obtuse to acute; petioles subequal in length at each node, 4–10 cm; leaf blade subequal in size at each node, 7–11 × 6–10 cm, ± orbicular, broadly ovate when young, peltate, succulent, chartaceous when dry, green on both surfaces, gray-green when dry, base emarginate, subtruncate to rounded, margin entire or inconspicuously undulate, apex acute or shortly acuminate, 3-veined, lateral veins 4 or 5 each side, inconspicuous, external secondary veins 7 to 9, anastomosing close to the margin, cystoliths fusiform, often conspicuous adaxially. Inflorescences solitary, in upper nodes, staminate inflorescence a cymose panicle, 8–20 cm, peduncle 4–10 cm; bracts narrowly ovate, ca. 0.3 mm; pistillate inflorescence shorter and narrower than staminate inflorescence, 6–15 cm, peduncle 1.5–6 cm. Staminate flowers pink, pedicellate, obovoid in bud, 1.2–1.5 mm, perianth lobes 4, obovate, connate for their basal half, subapical appendage corniculate; stamens 4; pistillate flowers 0.4–0.5 mm, light green, subsessile, perianth lobes 3, unequal, the dorsal lobe cymbiform, as long as the achene, the subapical appendage strongly corniculate, the lateral lobes deltate, half the length of the achene; staminodes oblong; ovary with an oblique apex, stigma sessile, shortly penicillate. Achene narrowly ovoid, ca.

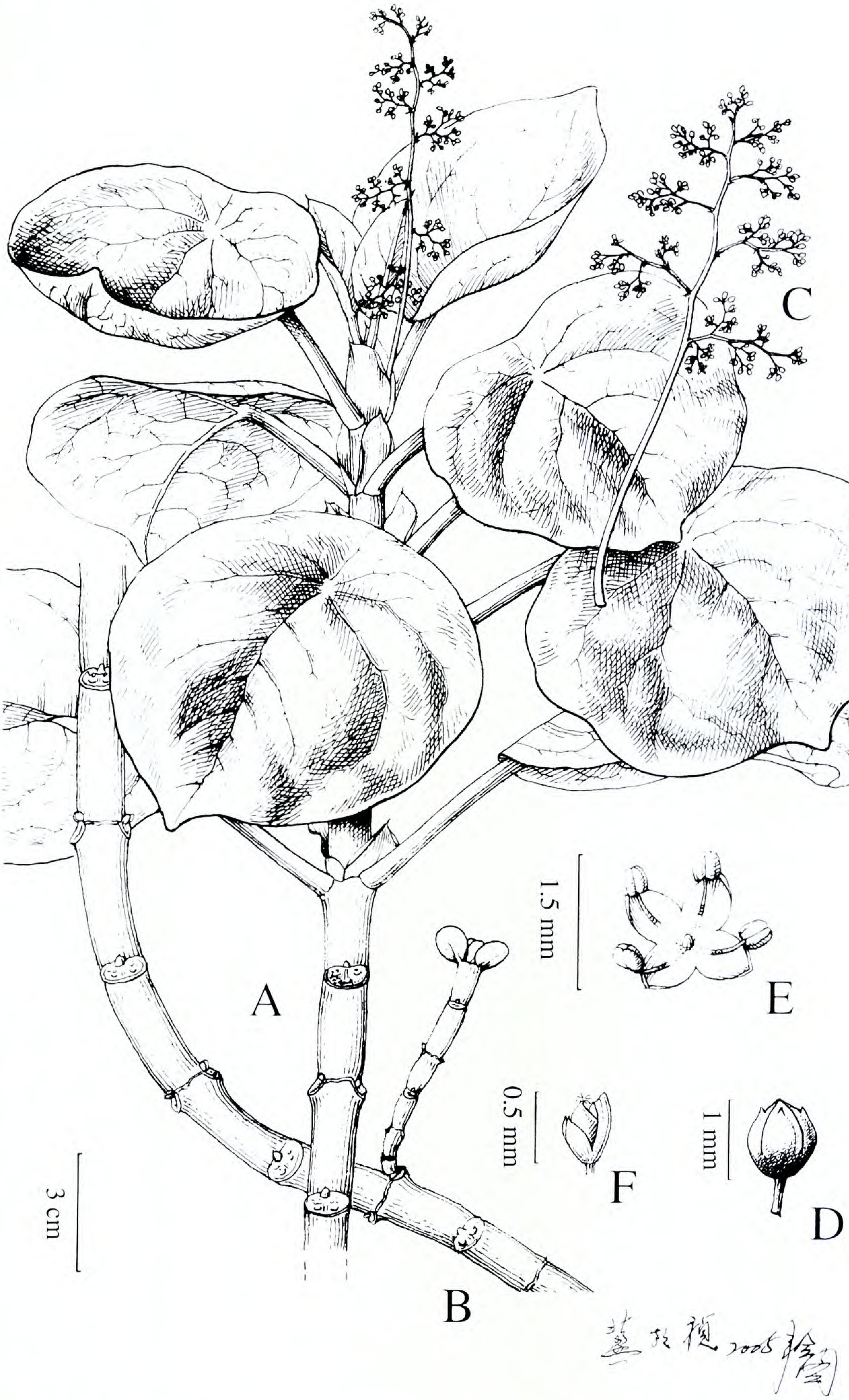

Figure 1. *Pilea panzhihuaensis* C. J. Chen, A. K. Monro & L. Chen. —A. Habit. —B. Plant base. —C. Staminate inflorescence. —D. Staminate flower in bud. —E. Staminate flower at anthesis, showing perianth, androecium, and rudimentary gynoecium. —F. Pistillate flower, showing perianth and distal half of the gynoecium. Scale bar common to A, B, and C. Illustrations by C. Z. Ji. A–C based on *Chen & Chen 2004-001* (PE); D–F based on *Chen 2003-001* (PE).

0.6 mm, weakly compressed, oblique, verrucose, tepals persistent.

This species was incorrectly ascribed by Léveillé (1914) to the genus *Podophyllum* L. (Berberidaceae). Recognizing this, Handel-Mazzetti (1929) transferred Léveillé's species to *Pilea*, reducing it to the synonymy of *Pilea peperomioides* Diels (Diels, 1912). However, Léveillé's species is distinct from *P. peperomioides* in leaf arrangement, stem, and stipule morphology. The leaves of *P. panzhihuaensis* are decussate as opposed to the spirally arranged leaves of *P. peperomioides*, the stipules have obtuse (with a minute apiculus) as opposed to long-acute to acuminate apices, and the stems have much longer internodes and grow to over 1 m in length as opposed to less than 0.5 m.

The specific epithet "cavaleriei" cannot be used in combination with *Pilea*, as it would be a later homonym of *Pilea cavaleriei* H. Léveillé (1912). Because the species described as *Podophyllum cavaleriei* lacks an available name once transferred to *Pilea*, we here propose the new name *Pilea panzhihuaensis*.

Phenology. Flowers from April to June; fruits from June to August.

Habitat, distribution, conservation status, and eponymy. This taxon is endemic to southwestern China, specifically southwestern Sichuan and western Guizhou, where it is found in forests on rocks in shady, moist, moss-rich places at altitudes of 1500–1900 m. The similarity of this taxon to *Pilea peperomioides*, which is widely cultivated as an ornamental, indicates that *P. panzhihuaensis* may have horticultural potential. It has been collected rarely and can probably be considered very rare. The local names for this taxon are Jing Mian Hua and Pa Qing Teng (L. Chen, pers. comm., 2001), which refer to the plant's orbicular leaves and the inflorescence extending beyond the leaves. This species takes its name from the locality for recently collected material.

Additional specimens examined. CHINA. **Sichuan:** Miyi County, Panzhihua, *L. Chen 2002-01* (PE), *C. J. Chen 2003-001* (PE), *2003-002* (PE), *C. J. Chen & L. Chen 2004-001* (PE), *2004-002* (PE), *C. J. Chen 2006-01 & 02* (PE).

Pilea spicata C. J. Chen & A. K. Monro, nom. nov. Replaced name: *Smithiella myriantha* Dunn, Bull. Misc. Inform. Kew 1920(6): 211. 1920. *Aboriella myriantha* (Dunn) Bennet, Indian Forester 107(7): 437. 1981. *Dunniella myriantha* (Dunn) Rauschert, Taxon 31(3): 563. 1982. TYPE: [India]. "Eastern Himalaya, Outer Abor Hills, on the sunless side of the Dihong Gorge in dark, damp places below Rotung at 300 m," *J. H. Burkill 36076* (lectotype, designated here, K).

Although Chen and Monro (2003) used the binomial *Pilea myriantha* (Dunn) C. J. Chen, this is a later homonym of *P. myriantha* Killip and is therefore illegitimate. *Pilea spicata* is therefore published here as a replacement name for *P. myriantha*. This species takes its name from the spicate pistillate inflorescences.

Pilea gracilis Handel-Mazzetti, Symb. Sin. 7: 136. 1929. TYPE: China. Yunnan: Simao, forest ravines, 4000 ft., *A. Henry 13352* (lectotype, designated by Chen, 1982: 87, IBSC).

Pilea verrucosa Handel-Mazzetti, Symb. Sin. 7: 134. 1929, nom. illeg., non *P. verrucosa* Killip, J. Wash. Acad. Sci. 15: 53. 1925. TYPE: China. Hunan: Wukang, Guangyin Temple, 1180 m, 18 June 1918, *Handel-Mazzetti 12145* (lectotype, designated by Chen, 1982: 55, K).

This taxon was formerly known as *Pilea verrucosa* Handel-Mazzetti. However, this name is a later homonym of *P. verrucosa* Killip. Therefore, the name *P. gracilis* Handel-Mazzetti has been selected as the next available name. In the original published description of *P. gracilis*, the type collection was erroneously cited as *A. Henry 1352*, rather than *A. Henry 13352* (Handel-Mazzetti, 1929).

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Una Nueva Combinación en *Microgramma* C. Presl (Pteridophyta–Polypodiaceae)

Elías R. de la Sota

Profesor, Facultad de Ciencias Naturales y Museo, UNLP, Paseo del Bosque, s/n, 1900 La Plata, Argentina; Investigador contratado "ad honorem", CONICET, Avda. Rivadavia 1917, 1033 Ciudad Autónoma de Buenos Aires, Argentina. sota@museo.fcnym.unlp.edu.ar

Abstract. A new combination in *Microgramma* C. Presl (Pteridophyta–Polypodiaceae) is proposed instead of *M. fuscopunctata* (Hooker) Vareschi, after the analysis of the type of *Polypodium dictyophyllum* Kunze ex Mettenius. Through the study of additional specimens and recent bibliography, the distributional pattern of this taxon for tropical America is specified.

Resumen. Se propone una nueva combinación en *Microgramma* C. Presl (Pteridophyta–Polypodiaceae), sobre la base de *Polypodium dictyophyllum* Kunze ex Mettenius, en lugar de *M. fuscopunctata* (Hooker) Vareschi, después de analizar el tipo del primer taxón nombrado. Estudiando otros especimenes y consultando bibliografía reciente, se precisa el área de distribución de esta especie en América tropical.

Key words: *Microgramma*, Polypodiaceae.

Tratando de poner al día aspectos morfoestructurales, sistemáticos y nomenclaturales de *Microgramma* C. Presl (Polypodiaceae) en América y África, van surgiendo novedades y problemas que se dan a conocer dentro del contexto del proyecto "Revision of the American Species of *Microgramma*" (Mickel & de la Sota, en prep.).

Consultando material pteridofítico en el Herbario de Munich (M), tuve la oportunidad de analizar ciertos especimenes de este género, con rizomas delgados y largamente rastreros, determinados primeramente como *Polypodium lycopodioides* L., *P. surinamense* Jacquin y *P. dictyophyllum* Kunze ex Mettenius.

Pongo particular atención a este último epíteto específico "dictyophyllum", que usualmente se lo considera un sinónimo de *Microgramma lycopodioides* (L.) Copeland (cf. Christensen, 1906: 522), mostrando a mi entender claras diferencias con la especie linneana, en lo que concierne a su rizoma mucho más delgado con escamas cuculadas y a sus láminas con indumento muy particular, caracteres que se pueden apreciar en mi contribución (Sota, 1986).

Cuando Maxon (1908: 501) discutió su nueva especie propuesta, *Phymatodes prominula* Maxon (= *Microgramma lycopodioides*, cf. Baksh-Comeau, 2000: 07), opinó que *Polypodium dictiophyllum*, de acuerdo a su descripción original es un taxón claramente diferente, como ya lo dijo Mettenius en su diagnosis.

Estos antecedentes me llevaron a replantear el nombre correcto de este especie tan particular de *Microgramma* (*M. fuscopunctata* (Hooker) Vareschi).

Aplicando la convencional e irremplazable metodología tipológica, se solicitó el ejemplar tipo de *Polypodium dictiophyllum*, precisando que el epíteto "dictyophyllum", publicado en 1856 es previo a "fuscopunctatum" aparecido en 1863. Se consultó lo pertinente en Código Internacional de Nomenclatura Botánica (Greuter, 2000), lo que condujo a una nueva combinación.

Microgramma dictyophylla (Kunze ex Mettenius) de la Sota, comb. nov. Basónimo: *Polypodium dictyophyllum* Kunze ex Mettenius, como "*dictiophyllum*", Abh. Senckenberg. Naturf. Ges. 2: 96. 1856. TIPO: [Guayana Francesa] "Guyana" sine loc., s.d., *M. E. (S.) Moricand s.n.* (holotipo, G).

Polypodium fuscopunctatum Hooker, Sp. Fil. 5: 69, t. 285a. 1863. *Microgramma fuscopunctata* (Hooker) Vareschi, Fl. Venez. 1(2): 893. 1969. *Pleopeltis fuscopunctata* (Hooker) R. M. Tryon & A. F. Tryon. Rhodora 84: 129. 1982. TIPO: Ecuador, Chimborazo, 3000 ft., s.d., *R. Spruce 5734* (holotipo, K).

Polypodium nematorhizon D. C. Eaton, Bot. Gaz. 3: 89. 1878. *Phymatodes nematorhizon* (D. C. Eaton) Underwood, Contr. U.S. Natl. Herb. 10: 493. 1908. TIPO: Trinidad, sine loc., s.d., *Fendler 73* (holotipo, GH; isotipo, M).

En mi contribución (Sota, 1986) y bajo *Polypodium fuscopunctatum*, se describen características de esta especie tan particular de *Microgramma.*

De acuerdo al material estudiado y a la bibliografía consultada, este taxón crece como epifito desde Costa Rica hasta Bolivia y por el Este hasta Venezuela, Guayanas y Brasil (estados de Acre y Amapá), entre 200 y 900 metros de altura.

Material adicional estudiado. BOLIVIA. Chapare, Villa de Tunari, *Wygodzinsky s.n.* (LP). BRASIL. Nordbrasilien, Rio Oyapock, Iyarapá, *v. Luetzelburg s.n.* [Bras. Grenzexped. Rondon 20270] (M). COLOMBIA. Villavicencio (Bogotá), s. coll., s.n. (M 0032391). COSTA RICA. Cartago, Río Tuis, *Döbbeler 927 & Menjivar* (M). ECUADOR. Cordillera Occidental, Rio Suguibi, *Reinbach s.n.* [Rosenstock 40] (M). PERU. Loreto, above Pongo de Mauseriche, Río Santiago, *Mexía 6144a* (US). VENEZUELA. Island of Margarita, Juan Diego trail, *Johnston 147* (M).

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A Noteworthy New Species of *Peritassa* (Celastraceae, Hippocrateoideae) from Amazonian Brazil

Julio Antonio Lombardi

Departamento de Botânica, Instituto de Biociências, Universidade Estadual Paulista 'Júlio de Mesquita Filho', Av. 24-A 1515, 13506-900, Rio Claro, São Paulo, Brazil. cissus@rc.unesp.br

Abstract. The new species *Peritassa manaoara* Lombardi differs from other species in *Peritassa* Miers by its unique 3-lobed stigma. The inclusion of this new taxon in *Peritassa* was based on the characteristics of non-confluent anther locules and the disc free from the ovary wall, which distinguishes this species from *Tontelea* Aublet, the only other genus of Neotropical Hippocrateoideae species with a 3-lobed stigma and tubular nectariferous disc.

Resumo. A nova espécie *Peritassa manaoara* Lombardi é distinta de todas as outras espécies de *Peritassa* Miers pelo seu estigma trilobado único. A inclusão deste taxon novo em *Peritassa* foi baseada na característica das anteras com lóculos não confluentes e disco nectarífero livre da parede do ovário, isso coloca essa espécie aparte daquelas incluídas em *Tontelea* Aublet, o único outro gênero Neotropical de Hippocrateoideae com espécies com estigma trilobado e disco tubular.

Key words: Amazon basin, Brazil, Celastraceae, Hippocrateoideae, IUCN Red List, *Peritassa*.

The Hippocrateaceae are now included in Celastraceae as the subfamily Hippocrateoideae, a taxon including five tribes, 24 genera, and ca. 357 described species (Hallé, 1990; Mennega, 1997) distributed worldwide in tropical and subtropical areas.

The delimitations of Neotropical genera in the Hippocrateaceae are notoriously controversial and range from two, *Salacia* L. and *Hippocratea* L. (Peyritsch, 1878), to 17, according to Miers (1872). In this work, I follow Smith (1940), who recognizes three genera segregated from *Salacia*, *Cheiloclinium* Miers, *Peritassa* Miers, and *Tontelea* Aublet and included in the tribe Salacieae with the African *Salacighia* Loesener and *Thyrsosalacia* Loesener (Mennega, 1997).

The genus *Peritassa*, with 17 described species (Lombardi, 2004; Lombardi & Temponi, 1999; Mennega, 1997) is exclusively Neotropical. It was described by Miers (1872) and segregated from *Salacia* because of the presence of anthers with a longitudinal dehiscence and a prominent connective, and of a tubular nectariferous disc. Other species with no prominent connective and different dehiscence were added later (Lombardi, 2004; Lombardi & Temponi, 1999; Smith, 1940).

These species have inconspicuous anther connectives and oblique dehiscence clefts, almost transverse, and are distinguished from other fleshy-fruited genera (tribe Salacieae, Mennega, 1997) by their anther locules not confluent at the apex, although dehiscent by oblique clefts (Smith, 1940: 501).

While working on a taxonomic study of the Brazilian species of Hippocrateoideae as part of a study of the Neotropical species, I discovered a noteworthy new species from the rainforests around Manaus, in the Brazilian Amazon basin.

Peritassa manaoara Lombardi, sp. nov. TYPE: Brazil. Amazonas: Reserva Flor. Ducke, Manaus–Itacoatiara, km 26, 02°53′S, 59°58′W, Igarapé do Tinga, Floresta de Campinarana, 7 Dec. 1994, *A. Vicentini 789 & E. C. Pereira* (holotype, IAN; isotypes, G not seen, INPA not seen, K not seen, MO not seen, NY not seen, RB, SP not seen, U not seen). Figure 1.

Haec species *Peritassae laevigatae* (Hoffmannsegg ex Link) A. C. Smith foliis et inflorescentia structura affinis, sed inflorescentia puberula, antheris globosis et stigmate 3-lobato differt. Ab omnibus speciebus sympatricis *Tonteleae* disco parietum ovarii libero et thecis in antherarum dehiscentia non confluentibus differt.

Liana, branches terete, new branches sparsely puberulous, older glabrescent, fissured. Leaves opposite to subopposite; stipules not seen, caducous; petioles 1.6–2 cm, canaliculate, glabrous; blades (15.4–)16.2–18.6(–19.8) × 6.5–6.8(–8.7) cm, elliptic, the base cuneate, the apex acute or acuminate, the margin entire and thickened, glabrous, chartaceous, drying brown on the adaxial side and light brown and minutely tuberculate on the abaxial side, or brown on both sides, the nerves drying cream on the abaxial side, venation brochidodromous, veins prominulous on both sides, secondary veins inconspicuous. Inflorescence paniculate, (4.5–)6.3–6.7 × (2.5–)6.5–8.5(–10.5) cm,

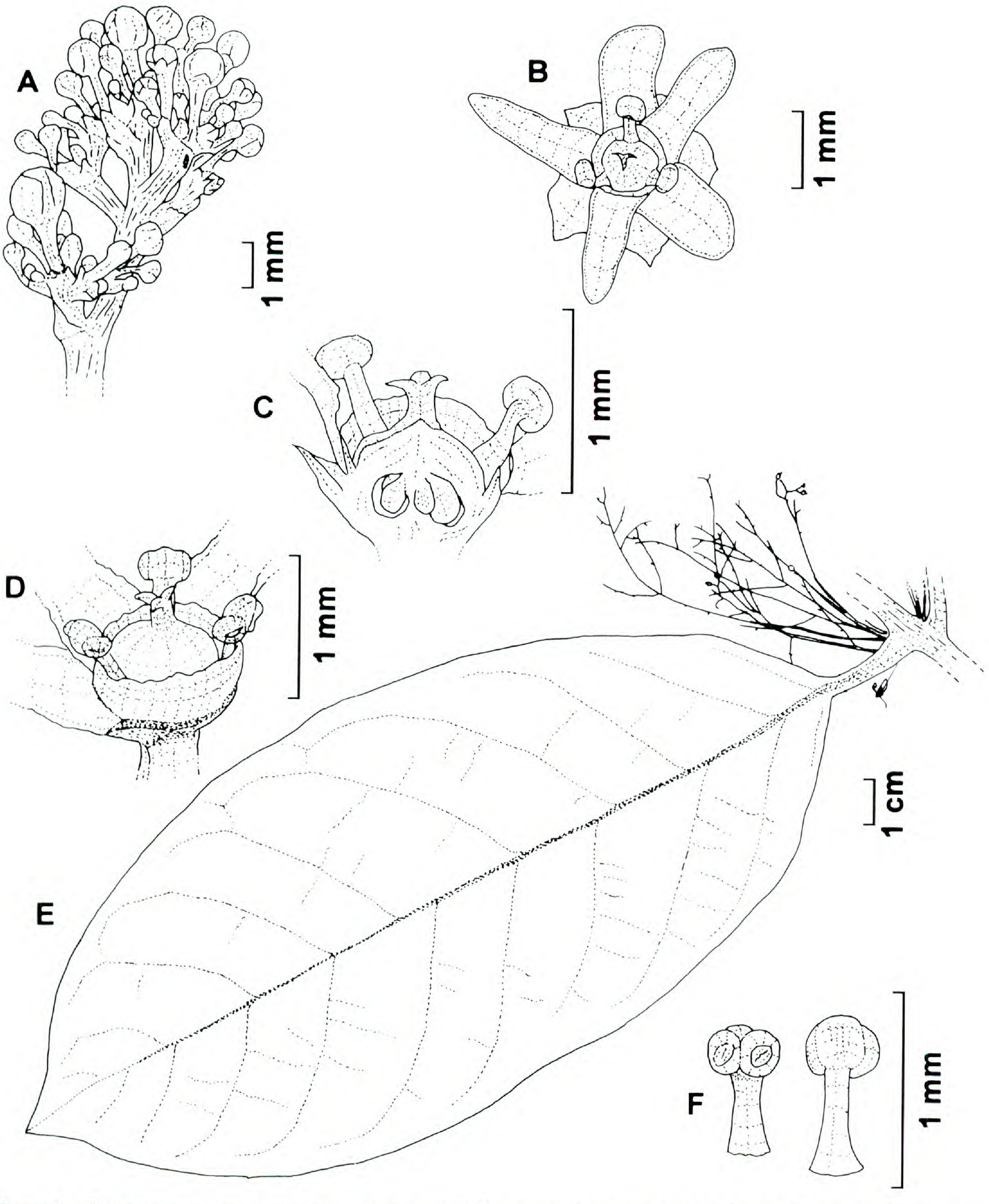

Figure 1. *Peritassa manaoara* Lombardi. —A. Apex of inflorescence branch. —B. Apical view of an open flower. —C. Lateral view of the middle section of an open flower showing disc, two stamens, and pistil. —D. Detail of an open flower showing disc, stamens, and pistil. —E. Branch with leaf and inflorescence. —F. Lateral and adaxial view of stamens. Drawings by the author: A from *Bahia 222* (U); B–D, F from *Assunção 726A & Souza* (MG); E from the holotype *Vicentini 789 & Pereira* (IAN).

with more than 400 flowers, axillary, sometimes at leafless nodes; peduncle obsolete, branches alternate or subopposite, terete, yellow-green, puberulous; bracts 0.5–0.7 mm, triangular, the base puberulous, the margin fimbriate, proximal inflorescence dichotomies without bracts; pedicels (0.3)1.3–1.6 mm, terete, green, glabrous; bracteoles 0.3–0.4 mm, triangular, the base puberulous, the margin fimbriate. Flowers ca. 3.4 mm wide at anthesis; sepals 5, 0.8–0.9(–1.3) × 0.8–1.2 mm, triangular, unequal, green, glabrous, ± carnose, the margin fimbriate, minutely revolute; petals 5, (1.3–)1.6–1.9 × (0.7–)0.8–0.9 mm, elliptic, yel-

lowish green or yellowish white, glabrous, ± carnose, spreading at anthesis, transversally brown-maculate, the margin scarious; disc short-tubular, ca. 0.3 mm high, ± carnose, free from reproductive parts, the margin minutely erose; stamens 3, 0.37–0.64 mm, in open flower slightly reflexed, the filaments flattened, the connective adaxially thickened, rounded at apex, slightly surpassing the thecae, the anthers 0.25–0.29 × 0.36–0.43 mm, gray, globose, basifixed, dehiscence extrorse by minute oblique slits; pistil 0.65 × 0.55 mm, ovary sub-spheroid, 3-locular, with 2 apical ovules in each locule, style ca. 0.32 mm after anthesis, central, terete, stigmas 3-lobed, ca. 0.18 mm diam. after anthesis, lobes ca. 0.1 mm after anthesis, entire, acute, appressed in bud. Mature drupes not seen, immature 2 × 1.8 cm, globose, pruinose; seeds not seen.

Phenology. Collected with flower buds in October and open flowers in November and December; collected with young fruits in March.

Distribution and habitat. *Peritassa manaoara* has been found in the rainforests around Manaus, capital city of the State of Amazonas, Brazil, and was also collected once in the Alto Rio Negro region, close to the Colombia–Brazil border.

In the Manaus region, where the Rio Negro converges with the Rio Solimões to form the Amazon River, several types of forests exist on flooded or not flooded areas in addition to forested to open shrubby formations on white sandy soils; the altitude ranges between 16 and 130 m (Nelson & Herrera-MacBryde, 1997). Two collections of this new species were made inside the Adolpho Ducke Forest Reserve, a governmental research station managed by the Instituto Nacional de Pesquisas da Amazônia (INPA), which harbors ca. 2200 vascular plant species (Ribeiro et al., 1999) and includes forest on gentle slopes, Amazonian caatinga forest (campinarana), and black-water flood forest (igapó), with little human alterations, although it is in the process of being enclosed by the expanding urban area of Manaus (Ribeiro et al., 1999).

Conservation status. The occurrence inside the Adolpho Ducke Forest Reserve guarantees the preservation of this species in the near future, but the population status and the conservation perspectives outside the Forest Reserve are unknown, and *Peritassa manaoara* is classified as Data Deficient (DD) by the IUCN Conservation Status categories.

Etymology. The specific epithet of this species refers to Manaus city, capital of the State of Amazonas, in northern Brazil; the city Manaus was named for the Manu tribe, Aruake stem, that used to live there.

Although this new species resembles *Peritassa laevigata* through its leaves and general inflorescence pattern, it can be immediately distinguished by the presence of indument, anther shape (globoid vs. triangular), connective apex (rounded vs. apiculate), and 3-lobed stigma (vs. punctiform, unlobed stigma).

Close examination of the stamens with non-confluent thecae and of the free nectariferous disc prevents any possible misidentification of this new species with the *Tontelea* species to which the presence of a lobed stigma could lead. The genus *Tontelea* distinguishes itself from *Peritassa* through the slits in the anther dehiscence (confluent on *Tontelea* vs. non-confluent on *Peritassa*) and the nectariferous disc adnation to the ovary wall (adnate on all 3-lobed stigma *Tontelea* species vs. free on all *Peritassa* species). *Tontelea* species also have relatively large oblong anthers (0.2–0.4 × 0.3–0.6(–0.8) mm) with clearly transverse dehiscence slits and, as in the newly described species, 3-lobed stigmas; the exceptions are the aberrant species *T. cylindrocarpa* (A. C. Smith) A. C. Smith, *T. myrsinoides* A. C. Smith, and *T. nectandrifolia* (A. C. Smith) A. C. Smith, which have relatively smaller anthers (0.1–0.3 × 0.2–0.3 (–0.5) mm) and unlobed stigmas.

While the generic placement of the three divergent *Tontelea* species is still to be studied, the placement of *Peritassa manaoara* in the present genus follows the generic characteristics as defined in the monograph by Smith (1940).

Peritassa manaoara was cited as *Tontelea fluminensis* (Peyritsch) A. C. Smith in Ribeiro et al. (1999: 473), presenting a small color image of the flowers of this species on the lower left corner of the page.

Paratypes. BRAZIL. **Amazonas:** Res. Flor. Ducke, Manaus–Itacoatiara, km 26, próximo à torre, 27 Nov. 1997, *P. A. C. L. Assunção 726A & M. A. D. Souza* (MBM, MG); Manaus, estr. Itaquatiara, 30 Nov. 1962, *A. G. Andrade 1378 & M. Emmerich 1362* (R); Manacapuru, margem do lago grande, 9 Oct. 1976, *T. R. Bahia 222* (MG, U, UB); environs de Manaos, 1906, *M. Labroy s.n.* (P); margem da Estr. Perimetr. Norte [sic], Rio Negro, Uaupés, 4 Mar. 1975, *B. G. S. Ribeiro 830* (IAN).

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Three New South American Species of *Salacia* with Fasciculate Inflorescences (Celastraceae, Hippocrateoideae)

Julio Antonio Lombardi

Departamento de Botânica, Instituto de Biociências, Universidade Estadual Paulista 'Júlio de Mesquita Filho', Av. 24-A 1515, 13506-900, Rio Claro, São Paulo, Brazil. cissus@rc.unesp.br

Abstract. Three new fasciculate flowered species of *Salacia* L. (Celastraceae, Hippocrateoideae) from the Amazon basin are described: *S. acevedoi* Lombardi is distinguished by its small flowers, stamens with short filaments, disc connate to ovary, and size of fruits; *S. negrensis* Lombardi differs by its habit, characteristics and shape of leaves, flower diameter, features and size of stamens, and number of ovules; and *S. odorata* Lombardi is characterized by its long pedicels, conical flower buds, strongly adherent petals, and flat disc with fimbriate outer border.

Resumo. São descritas para a bacia amazônica três novas espécies de *Salacia* L. (Celastraceae, Hippocrateoideae) com inflorescências fasciculadas, *S. acevedoi* Lombardi a qual se distingue pelos estames pequenos com filetes curtos, disco conado ao ovário e pelo tamanho dos frutos; *S. negrensis* Lombardi difere pelo hábito, características e forma das folhas, diâmetro da flor, características e tamanho dos estames, e número de óvulos; e *S. odorata* Lombardi é caracterizada pelos pedicelos longos, botões florais cônicos, pétalas fortemente aderentes e disco achatado com margem externa fimbriada.

Key words: Brazil, Celastraceae, Ecuador, Hippocrateoideae, IUCN Red List, Peru, *Salacia*.

The former family Hippocrateaceae is now included in Celastraceae as a subfamily that comprises five tribes, 24 genera, and ca. 357 described species (Hallé, 1990; Mennega, 1997) distributed worldwide in tropical and subtropical areas.

Delimitation of the Hippocrateoideae genera is controversial. The number of genera range from two, *Salacia* L. and *Hippocratea* L. (Peyritsch, 1878), to 17, according to Miers (1872). In this work I follow Smith (1940), who recognizes three genera segregated from *Salacia*, *Cheiloclinium* Miers, *Peritassa* Miers, and *Tontelea* Aublet and included in the tribe Salacieae with the African *Salacighia* Loesener and *Thyrsosalacia* Loesener (Mennega, 1997).

Salacia is a genus with ca. 200 species (Mennega, 1997), distributed worldwide in the tropics and subtropics. Smith (1940) recognized 29 species from the Neotropics, of these 14 with fasciculate inflorescences. Since then, Mennega described four others (Mennega, 1984, 1991), three of which have fasciculate inflorescences. The last comprehensive taxonomic study of the genus, although unpublished, is by Hedin (1999), who recognized 38 species in the Neotropics, 20 of these with fasciculate inflorescences, including two new taxa from Ecuador and Peru.

The probable paraphyly of *Salacia* s. str. was pointed out by recent molecular studies (Hedin, 1999; Simmons et al., 2001a, b). Worldwide analyses of representative species from both the Old and the New Worlds are still needed before any generic realignment can be proposed.

While working on a taxonomic study of South American species of Hippocrateoideae as part of a study on the Neotropical species, I discovered three new species from the Amazon basin. These newly described species apparently occur only in small areas within forest extensions, but such distribution may be a sampling artifact.

1. Salacia acevedoi Lombardi, sp. nov. TYPE: Peru. Cuzco: Prov. Cuzco, Distr. Camisea, Campamento San Martín-C, Camisea Production Unit W of camp, 11°47′S, 72°41′W, 26 Jan. 1997, *P. Acevedo Rodríguez 9084, D. Bell, K. Rankin & S. F. Smith* (holotype, US [2]). Figure 1.

Haec species *Salaciae grandifoliae* (Martius ex Schultes) G. Don et *S. juruanae* Loesener foliis magnis et inflorescentiis fasciculatis affinis, sed floribus et staminibus minoribus, cavitatibus in margine interno disci nectariferi ubi stamina inserta et fructibus minoribus differt. A *S. grandifolia* distributione geographica distincta distat.

Slender or scandent shrub, 2–4 m, glabrous, branches terete to compressed, smooth, sparse lenticellate, drying green. Leaves opposite to subopposite; stipules not seen, caducous, leaving interpetiolar ring; petioles 1.2–2.5(–3.4) cm, canaliculate, drying wrinkled and green; blades (26.1–)33–40.5(–50) × (9.8–)15.2–17.2(–24.5) cm, elliptic, the base cuneate to rarely rounded, the apex acute, the margin

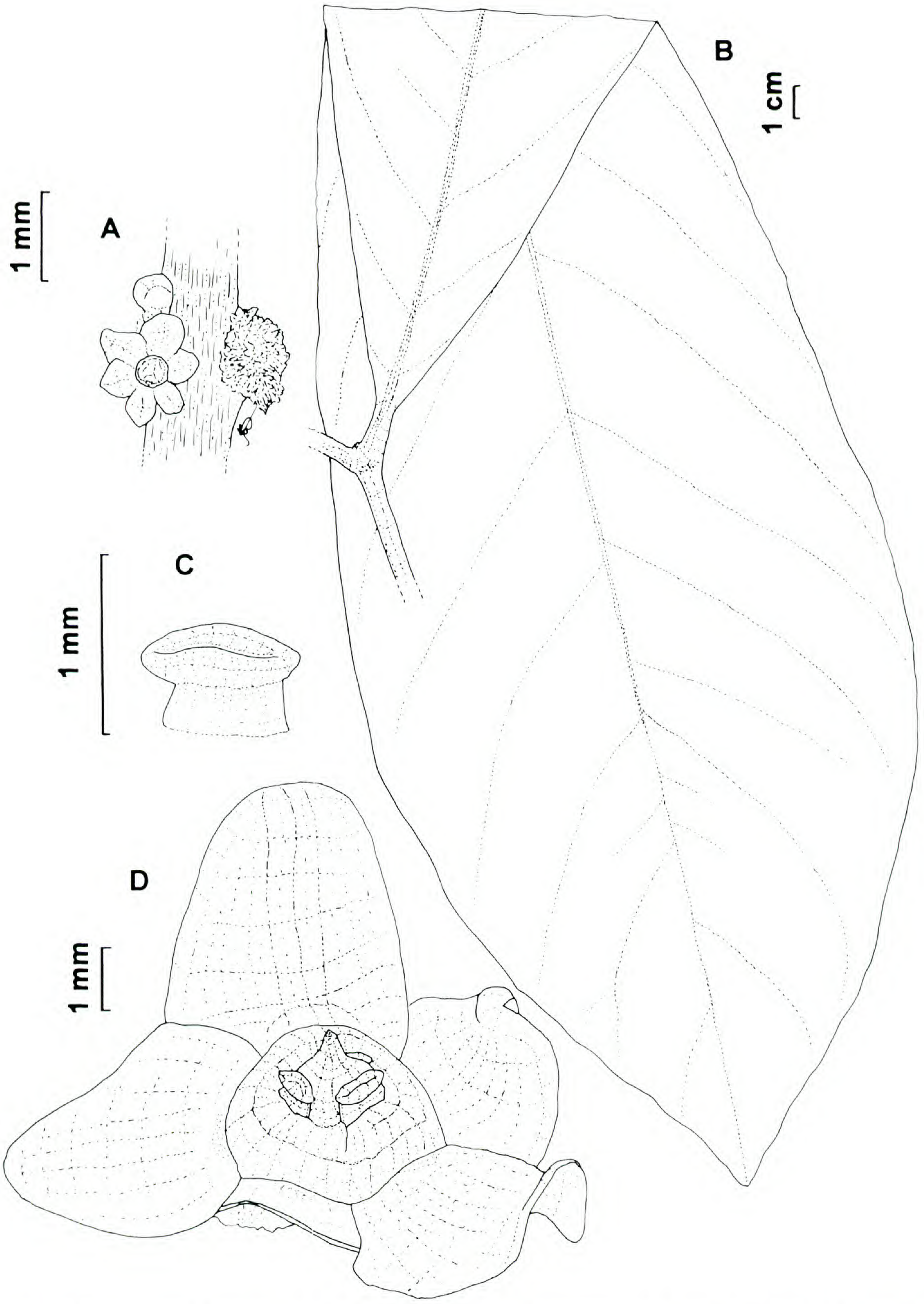

Figure 1. *Salacia acevedoi* Lombardi. —A. Detail of the fasciculate inflorescence. —B. Branch with leaf. —C. Abaxial view of stamen. —D. Apical view of flower. Drawings by the author: A, C–D from the holotype *P. Acevedo Rodríguez 9084 et al.* (US); B from *Wallnöfer 11-161188* (W).

entire and thickened, chartaceous, drying gray-green, venation brochidodromous with veins prominulous on both sides, secondary veins immersed, tertiary ones invisible. Inflorescence fasciculate, with indeterminate number of flowers, ramiflorous at leafless nodes, apparently flowering during successive seasons; bracts 0.7–0.8 mm, triangular, the margin minutely fimbriate; pedicels 2–2.4 mm, terete. Flower buds spherical,

open flowers yellowish green, 6.1–7.6 mm wide at anthesis; sepals 5, 1.3–1.8 × (0.8–)1.7–3.2 mm, triangular, unequal, carnose, yellowish green, the margin minutely erose; petals 5, 3.3–3.8 × 3.2–3.6 mm, widely elliptic, ± papery, spreading at anthesis, yellowish green and rusty brown at base on the adaxial side, the margin entire; disc annular-pulvinate, 0.6–0.9 mm wide, 0.7–1.1 mm thick, carnose, connate with ovary lobes, the outer margin not flattened, rounded at edge; stamens 3, 0.7–0.8 mm, anther only emerging on the stamen-pockets formed by the fusion of disc and ovary, the filaments flattened, wide but very short, the anthers 0.29–0.39 × 0.84–0.9 mm, transverse ellipsoidal, basifixed, bilocular, confluent thecae, dehiscence extrorse by apical slit at ca. 160°; pistil pyramid-shaped, ovary 3-lobed, 3-locular, with 2 ovules in each locule, style ca. 0.52 mm after anthesis, central, triangular, stigmas obscure. Mature drupes 2.3–2.7 × 2–2.6 cm, spheroid or ovoid, the epicarp crustaceous, smooth or slightly tuberculate, drying dark brown, immature with 3 clear strips; seeds 1.4–1.5 × 0.7–0.8 cm, ellipsoid.

Phenology. Collected with buds and flowers in November and January, collected with immature fruits in September, October, December, and January, and with mature fruits in January.

Distribution and habitat. Salacia acevedoi is apparently restricted to Peru, where it occurs at altitudes of ca. 260 or 400–500 m and was reported in moist and dry lowland forests.

Conservation status. This species occurs inside an official conservation unity (Bosque Nacional de Iparia) and is thus protected, but the population status inside and outside the conservation area is unknown and *Salacia acevedoi* is classified as Data Deficient (DD) by the IUCN Conservation Status categories.

Vernacular. Auca-Murcuhuasca (in Schunke Vigo 4642).

Etymology. The specific epithet of this species is homage to the type collector, Dr. Pedro Acevedo Rodríguez.

Salacia acevedoi resembles *S. grandifolia* and *S. juruana* (including *S. gigantea* Loesener), through its big leaves and shrubby habit, but *S. grandifolia* is restricted to the Brazilian Atlantic rainforest and has larger flowers (14.5–16.3 mm wide vs. 6.1–7.6 mm), stamen-pockets on its disc are not apparent, longer stamens (1.9–2.4 mm vs. 0.7–0.8 mm), totally yellow-green flowers (vs. petals with base rusty brown on the adaxial side), and bigger fruits (5.5 × 5.4 cm vs. 2.3–2.7 × 2–2.6 cm). *Salacia juruana* also differs from it through color of dried leaves (brown-olive or gray-green above and brown below vs. gray-green), bigger flowers (10.5–24.1 mm wide vs. 6.1–7.6 mm), stamen-pockets on disc not apparent, longer stamens (1.39–3.43 mm vs. 0.7–0.8 mm), and generally larger fruits ((2.3–)3.3–5.1 × (2.6–)3.2–3.5 cm vs. 2.5–2.7 × 2 × 2.7 cm).

Paratypes. PERU. **Huánuco:** Prov. Pachitea, Distr. Puerto Inca, Bosque Nacional de Iparia, a lo largo del Río Pachitea, ca. del pueblo de Puerto Inca, 9 Dec. 1968, *Schunke Vigo 2844* (F, US); Prov. Pachitea, region of Pucallpa, W part of the "Sira mountains" adjacent lowland, ca. 26 km S of Puerto Inca, biol. field stat. "Panguana," 16 Nov. 1988, *Wallnöfer 11-161188* (W), 19 Oct. 1988, *Wallnöfer 11-191088* (W), 17 Nov. 1988, *Wallnöfer 13-171188* (W). **Loreto:** SE of Pucallpa, next to jct. of Río Pachitea Río Yuyapichis, village of Panguana surroundings, ca. 260 m, 26 Sep. 1985, *Morawetz & Wallnöfer 118-26985* (W-2). **San Martín:** Prov. Mariscal Caceres, Dept. Tocache Nuevo, Puerto Pizana (margen derecha del Río Huallaga), 12 Jan. 1971, *Schunke Vigo 4642* (F, P, US).

2. Salacia negrensis Lombardi, sp. nov. TYPE: Brazil. Amazonas: Rio Negro, Ilha da Nova Vida, 26 Nov. 1947, *R. L. Fróes 22909* (holotype, IAN; isotype, SPF). Figure 2.

Haec species *Salaciae ellipticae* (Martius ex Schultes) G. Don structura inflorescentiae affinis, sed foliis praecipue ovalibus, nervis manifestis, staminibus et antheris minoribus, angulo dehiscentiae et forma antherarum differt. Etiam *S. impressifoliae* (Miers) A. C. Smith forma folii et structura inflorescentiae affinis, sed habitu, diametro floris et numero ovulorum in quoque loculo differt.

Shrub to small tree, 5–8 m, glabrous, branches terete, smooth, older fissured, punctiform lenticels sparse. Leaves opposite; stipules not seen, caducous, leaving interpetiolar ring; petioles (0.5–)1–1.5 cm, canaliculate, drying wrinkled and black; blades (16.2–)20.4–22.5(–27.5) × (6.7–)9.1–10.1(–13.6) cm, ovate to elliptic, the base rounded to cuneate, the apex acute, the margin entire and thickened, slightly revolute, chartaceous, drying dark brown on the adaxial side, light brown and minutely alveolate on the abaxial side, sometimes with darker or blackish costae and veins, venation brochidodromous, veins on both sides prominulous, secondary veins invisible or slightly immersed. Inflorescence fasciculate, with an indeterminate number of flowers, ramiflorous at leafless nodes, apparently flowering during successive seasons; bracts ca. 0.3 mm, triangular, the margin fimbriate; pedicels 3.3–5.4 mm, terete, pruinose. Flower buds spherical, open flowers reported as green (*Ducke 684*) or rose-yellow (*Fróes 22909*), 6.6–7.6 mm wide at anthesis; sepals 5, 0.8–1.4(–1.8) × 1–1.2(–2.3) mm, triangular or rhombic, unequal, ± carnose, the base pruinose, the margin minutely erose; petals 5, (2.6–)3.2–3.9

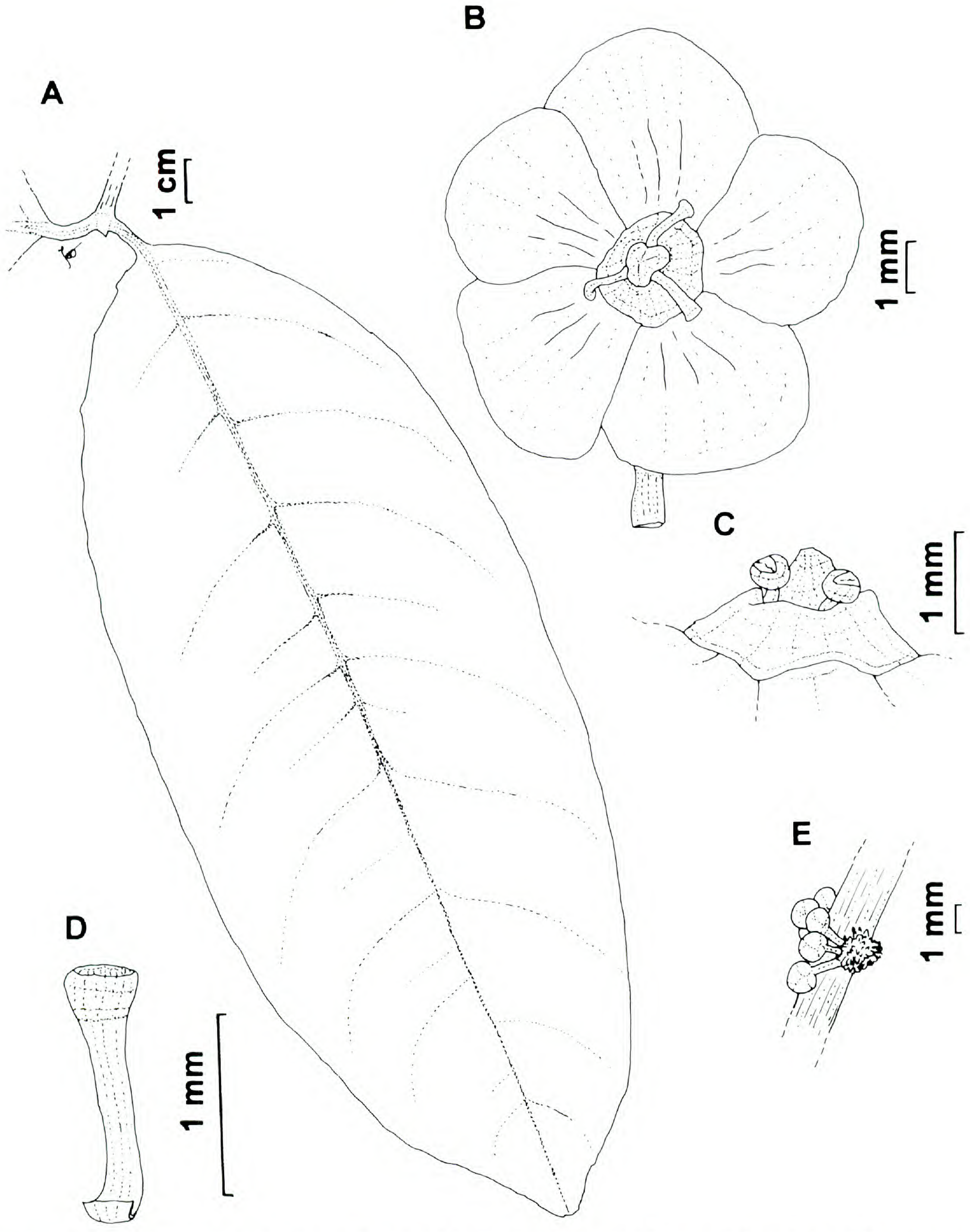

Figure 2. *Salacia negrensis* Lombardi. —A. Branch with leaf. —B. Apical view of flower. —C. Lateral view of disc, stamens, and pistil. —D. Abaxial view of stamen. —E. Detail of the fasciculate inflorescence. Drawings by the author: A, E from *Ducke 684* (NY); B–D from the holotype *Fróes 22909* (IAN).

× 3–3.8(–4.3) mm, widely elliptic, papery, spreading at anthesis, the base marked by divergent strips, the margin entire; disc annular-pulvinate, 0.42–0.9 mm high, 0.62–0.96 mm thick, carnose, free from reproductive parts, the outer margin not flattened, rounded at edge; stamens 3, ca. 0.89 mm, spreading after anthesis, the filaments flattened, the anthers 0.19–0.22 × 0.27–0.43 mm, ellipsoidal, dorsifixed, bilocular, confluent thecae, dehiscence extrorse by apical slit at 180°; pistil pyramid-shaped, pruinose,

ovary 3-lobed, 3-locular, with 2 ovules in each locule, style smashed in examined specimens, central, triangular, stigmas obscure. Mature drupes ca. 3.9 × 4.5 cm, spheroid, the epicarp crustaceous, smooth, drying dark brown with pruinose irregular strips; seeds ca. 2.3 × 1.3 × 1 cm, polygonal.

Phenology. Collected with flowers in January, March, and November; collected with immature fruits in January and mature fruits in April.

Distribution and habitat. *Salacia negrensis* occurs in seasonally flooded forests (mata de várzea) in the State of Amazonas along the Rio Negro and its affluent Rio Branco in the State of Roraima.

Conservation status. The most recent collection of this species is dated 28 Apr. 1974 (*J. M. Pires et al. s.n. [IPEAN 14383]*); new collections are unknown, and the conservation status of this species is Data Deficient (DD) by the IUCN categories. I have failed to define the precise location of the collection localities, all of them Rio Negro islands, except for Baia Boiassu (Boiaçú) [01°37′59″S, 61°25′54″W], near the confluence of middle Rio Negro and Rio Branco.

Etymology. The specific epithet of this species is a reference to the Amazonian Rio Negro, along which most of the specimens were collected.

This new species resembles *Salacia elliptica* through its inflorescences, but differs from it through its predominantly ovate leaves with prominulous veins (vs. elliptic to rhombic leaves with veins immersed on both sides or slightly prominulous only on the abaxial side), smaller stamens (ca. 0.89 mm vs. 1.07–2.5 mm) and anther (0.19–0.22 × 0.27–0.43 mm vs. 0.37–0.59 × 0.53–0.84), and anther dehiscence angle (180° vs. 130°) and shape (elliptic vs. reniform). *Salacia negrensis* also resembles *S. impressifolia*, chiefly through its leaf shape and inflorescence type, but is easily distinguished through its habit (shrub or tree vs. liana), flower diameter (6.6–7.6 mm vs. 10.8–21.1 mm), and ovule number per locule (2 vs. 6).

Paratypes. BRAZIL. **Amazonas:** baixo Rio Negro, ilhas da baia Boiassu [sic, Boiaçú], 24 Mar. 1941, *A. Ducke 684* (F, IAN, MG, NY, R, RB-2); Paraná-ubim, Rio Negro, 31 Jan. 1959, *J. S. Rodrigues, J. M. Pires & N. T. Silva 8* (IAN); Rio Negro, Ilha da Independência, 17 Apr. 1952, *R. L. Fróes 28287* (IAN). **Roraima:** perto da boca do Rio Ajarani com o Rio Branco, 28 Apr. 1974, *J. M. Pires, P. B. Cavalcante, H. Magnano & N. T. Silva s.n. [IPEAN 14383]* (IAN). Sine loc., *Instituto Agronômico do Norte 11* (IAN).

3. Salacia odorata Lombardi, sp. nov. TYPE: Ecuador. Esmeraldas: Quinindé Cantón, Bilsa Biological Station, Reserva Ecológica Mache-Chindul, 35 km W of Quinindé, 00°21′N, 79°44′W, 500 m, 18 Nov. 1996, *J. L. Clark, F. Gurumendí & H. Weinert 3434* (holotype, MO; isotype, QCNE not seen). Figure 3.

Haec species *Salaciae cordatae* (Miers) Mennega forma, textura et colore foliorum desiccatorum affinis, sed floribus fasciculatis et disco applanato absque denticulis apicem versus differt. Ab omnibus speciebus similibus generis floribus fasciculatis, pedicellis longis, petalis fortiter adhaerentibus in alabastro, cicatricibus quarum persistentibus post anthesin et disco applanato margine externo fimbriato abunde differt.

Tree, (4–)8–10(–20–25) m, DBH 12–20 cm, glabrous, branches terete, fissured (longitudinal lenticels?), frequently covered by epiphyllous bryophytes. Leaves opposite to subopposite; stipules 0.4–0.5 mm, triangular, margin fimbriate, early caducous, not leaving interpetiolar ring; petioles (0.6–)0.8–1.2(–2.3) cm, canaliculate, lenticellate, drying green; blades (11–)11.7–18.5(–24.2) × (3.4–)4–7.3(–12.5) cm, elliptic, the base cuneate, rarely rounded, the apex acuminate, the margin entire and slightly thickened, chartaceous, drying green or sometimes brown, venation brochidodromous, veins on both sides prominulous, secondary veins invisible or slightly immersed, abaxial side minutely punctuate and tuberculate. Inflorescence fasciculate, with indeterminate number of flowers, ramiflorous at leafless nodes or axillary, apparently flowering during successive seasons; bracts ca. 0.8 mm, triangular, the margin fimbriate; pedicels 20–24 mm, terete, sometimes minutely tuberculate. Flower buds fusiform, open flowers reported as green (*Clark et al. 3434*) or orange (*Clark 3968*, *Clark et al. 4082*), ca. 14 mm wide at anthesis; sepals 5(to 6), 1.3–1.6 × 1.3–1.9 mm, triangular, unequal, ± carnose, the margin minutely denticulate; petals 5(to 6), 4.2–7.5 × 2.4–3.3 mm, elliptic, carnose, together firmly adherent in bud, after anthesis spreading and with distinct scar made by the overlapping petal, the margin entire; disc flat, 0.7 mm high, 1 mm wide, carnose, the inner margin raised in a thicker ring, the outer margin fimbriate, dark green; stamens 3(to 4), 1–2.4 mm, erect at anthesis, yellow-green, the filaments flattened, the anthers 0.4–1.1 × 0.7–0.9 mm, reniform, dorsifixed, unilocular, dehiscence extrorse by apical slit at ca. 160°; pistil pyramid-shaped, ovary 3-lobed, 3-locular, with 2 ovules in each locule, style ca. 0.7 mm, central, triangulate, stigmas obscure, punctiform. Mature drupes ca. 3.5 × 3 cm, spheroid, orange, the epicarp crustaceous, smooth or rough, drying dark brown with pruinose spots; seeds not seen.

Phenology. Collected with flowers in November, February, and March, collected with immature fruits

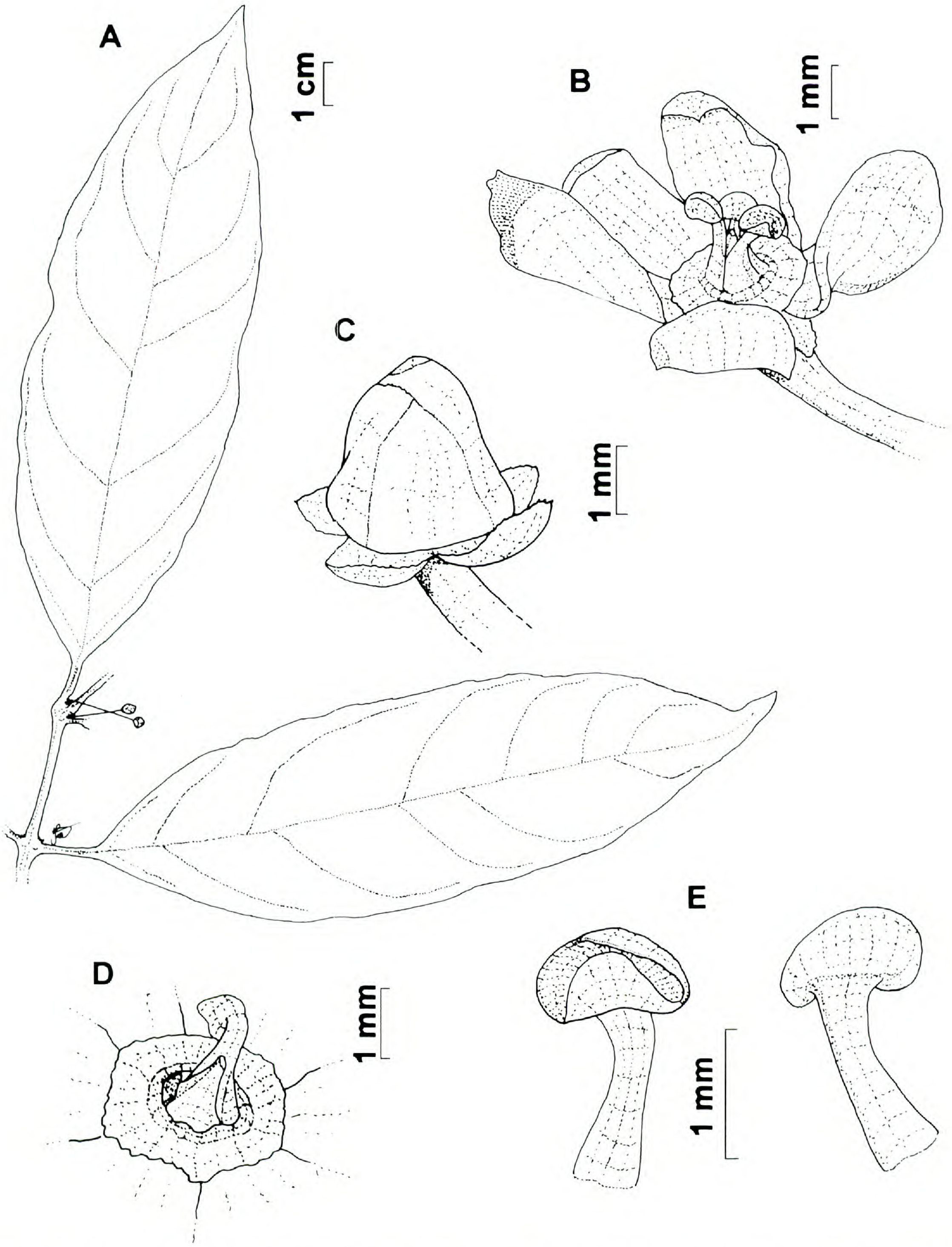

Figure 3. *Salacia odorata* Lombardi. —A. Branch with leaves and flowers. —B. Lateral view of flower. —C. Flower bud. —D. Apical view of an open flower showing disc, one stamen, and pistil. —E. Adaxial and abaxial views of stamens. Drawings by the author: A, C from *Cazalet & Pennington 5270* (US); B, D–E from *Clark et al. 4082* (BHCB).

in February and March, and with mature fruits in March.

Distribution and habitat. *Salacia odorata* occurs at altitudes of 305–650 m in seasonal rainforests and premontane wet forests of the Peruvian Department of Madre de Dios and of the Ecuadorian Provinces of Pichincha, Napo, and Esmeraldas.

Conservation status. The Bilsa Biological Station collection area in the Esmeraldas Province belongs to the Jatun Sacha Foundation, a private, nonprofit Ecuadorian NGO, and this species also occurs inside the Peruvian National Park of Manu, and the Ecuadorian Estación Científica Yasuní, which guarantees its preservation in the near future; however, the population status is unknown, and *Salacia odorata* is classified as Data Deficient (DD) by the IUCN Conservation Status categories.

Etymology. The specific epithet of this species is a reference to the wintergreen smell reported on the bark by the type collector. Wintergreen is the common name for *Gaultheria procumbens* L. and *Betula lenta* L., past and present sources, respectively, of medicinal methyl salicylate (Mabberley, 1987).

Salacia odorata resembles *S. cordata* through its shape, texture, and color of dried leaves but is distinguished from it through its inflorescence type (fasciculate vs. thyrsoid-paniculate) and very different flowers; in addition, the disc of *S. cordata* is tubular around the ovary and apically ends in three teeth. This species stands apart through its long pedicels, its petals that are strongly adherent in bud and marked after anthesis, and its flat disc with a thick ring on the inner border and the fimbriate outer border. These combined characteristics and the fasciculate inflorescence allow its easy recognition.

Paratypes. ECUADOR. **Esmeraldas:** Quinindé Cantón, Bilsa Biol. Stat., Reserva Ecol. Mache-Chindul, 40 km NW of Quinindé, Loma de los Guerrilleros, 19 Feb. 1997, *Clark 3968* (BHCB, MO); 35 km W of Quinindé, 20 Mar. 1998, *Clark & Pallis 4873* (MO); 35 km W of Quinindé, 5 km W of Santa Isabel, 6 Feb. 1996, *Clark, Kerber & Plihal 2034* (MO); 40 km NW of Quinindé, Loma de los Guerrilleros, 12 Mar. 1997, *Clark, Cousins, Nuñez & Richter 4035* (MO); 40 km NW of Quinindé, Loma de los Guerrilleros, 12 Mar. 1997, *Clark, Cousins, Nuñez & Richter 4082* (BHCB, MO); carr. Herrera–El Páramo (Santa Isabel), 18 Feb.–5 Mar. 1995, *Palácios, Clark & Jaramillo 13500* (MO); carr. vecinal Herrera–Los Monos, cabecera del Río Aguacatal, finca de Francisco Cantos, 24–26 Feb. 1995, *Palácios 13656* (MO). **Napo:** Estación Científica Yasuní, Río Tiputini, NW de la confl. con Río Tivacuno, 22 Jan. 1998, *Romoleroux 3066* (F); Pichincha: 20 km W of Santo Domingo de los Colorados, 3 Nov. 1961, *Cazalet & Pennington 5270* (US), 1 Nov. 1961, *Cazalet & Pennington 5244* (US). PERU. **Madre de Dios:** Prov. Manu, Parque Nac. del Manu, Río Manu, s.d., *Nuñez 14585* (F).

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Polygala riograndensis (Polygalaceae), a New Species from Southern Brazil

Raquel Lüdtke and Silvia Teresinha Sfoggia Miotto

Departamento de Botânica, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, 9500, Porto Alegre, Rio Grande do Sul, 91501-970, Brasil. raquelludtke@yahoo.com.br; stsmiotto@terra.com.br

Abstract. *Polygala riograndensis* Lüdtke & Miotto (Polygalaceae) is a new species from the Brazilian flora. This species is included in the subgenus *Polygala* L., which has the largest number of species in the Brazilian territory. *Polygala riograndensis* is closely related to *P. campestris* Gardner, but it is set apart mainly by the stems sinuate, capsules winged, leaves petiolate and glabrous, and by the crest of the keel with 6 to 7 lobes that are simple or bifid. This species was recognized during the revision of the genus *Polygala* in Rio Grande do Sul state. Morphological description, illustration, and observations about habitat and distribution are presented.

Resumo. *Polygala riograndensis* Lüdtke & Miotto (Polygalaceae) é uma nova espécie descrita para a flora brasileira. Esta espécie está incluída no subgênero *Polygala* L. que abrange o maior número de espécies no território brasileiro. *Polygala riograndensis* é afim de *P. campestris* Gardner, se diferenciando desta por apresentar os caules sinuosos, cápsula alada, folhas pecioladas e glabras e crista da carena dividida em 6 a 7 lobos. Esta espécie foi reconhecida durante a revisão taxonômica do gênero *Polygala* no Rio Grande do Sul. São fornecidas descrição morfológica, ilustração e observações sobre hábitats e distribuição.

Key words: Brazil, *Polygala*, Polygalaceae, Rio Grande do Sul.

With about 725 species, *Polygala* L. is the largest genus of Polygalaceae. Most species are distributed in the tropical regions, with an abundant distribution in the Central and South Americas, Africa, and Asia (Paiva, 1998).

The genus *Polygala* is represented in the Brazilian flora by 110 species and 30 varieties (Marques, 2003) and can be distinguished from other genera of Polygalaceae by the dehiscent capsule always with two seeds.

Several taxonomic revisions of the genus *Polygala* were realized in the past 20 years in Brazil, such as Marques (1984, 1988, 2003), Lüdtke and Miotto (2004), and Aguiar (2005).

In the Rio Grande do Sul state, 24 species of *Polygala* were recognized, with wide distribution occurring in the most diverse environments. During the revision of the genus *Polygala* in the state of Rio Grande do Sul (Lüdtke & Miotto, 2004), a new species was recognized.

Polygala riograndensis Lüdtke & Miotto, sp. nov. TYPE: Brazil. Rio Grande do Sul: Porto Alegre, Morro da Polícia, 10 Oct. 2003, *R. Lüdtke 190* (holotype, ICN). Figure 1.

Polygala riograndensis valde proxima *P. campestri* Gardner praecipue habitu, absentia glandularum, bracteis et bracteolis deciduis et racemis pedunculatis et cylindricis. Sed caulibus sinuosis, foliis petiolatis et glabris et crista carinae 6 ad 7 lobis simplicibus vel bifidis instructis et capsulis alatis differt.

Herbs decumbent, eglandular, 11–34 cm high; stems sinuate, cylindrical at base, quadrangular at apex, glabrate or densely pilose, with short trichomes, ca. 0.5–1 mm. Leaves petiolate, petiole 1–2 mm, alternate, membranous, glabrous, orbicular, widely ovate, or widely elliptic, 3–10 × 2.5–7 mm, apex apiculate, acuminate, or cuspidate, base acute, rounded, or obtuse, margins entire; bracts deciduous, lanceolate, subulate, 1.1–1.8 mm, margins ciliate; bracteoles deciduous, lanceolate, margins entire. Racemes pedunculate, terminal or axillary, narrowly cylindrical, 2–12 cm; floral rachis glabrous. Flowers 2–2.5 mm, white or greenish white, pedicels 0.5–1.2 mm, glabrous, pendulous in fruit; external sepals unequal, inserted at the same point, glabrous, apex acute, margins entire, 1 sepal ovate to elliptic, 1.1–1.5 mm, 2 sepals elliptic, 1–1.2 mm; internal sepals glabrous, elliptic, 1.5–2 mm, apex rounded, cucullate, base attenuate; lateral petals glabrous, elliptic, 1.5–2 mm, apex rounded, keel crested, crest 0.8–1 mm, with 6 to 7 lobes simple or bifid; ovary glabrous, fusiform. Capsule glabrous, ovate to orbicular or widely oblong, 1.3–1.8 mm, lacking stipe, winged,

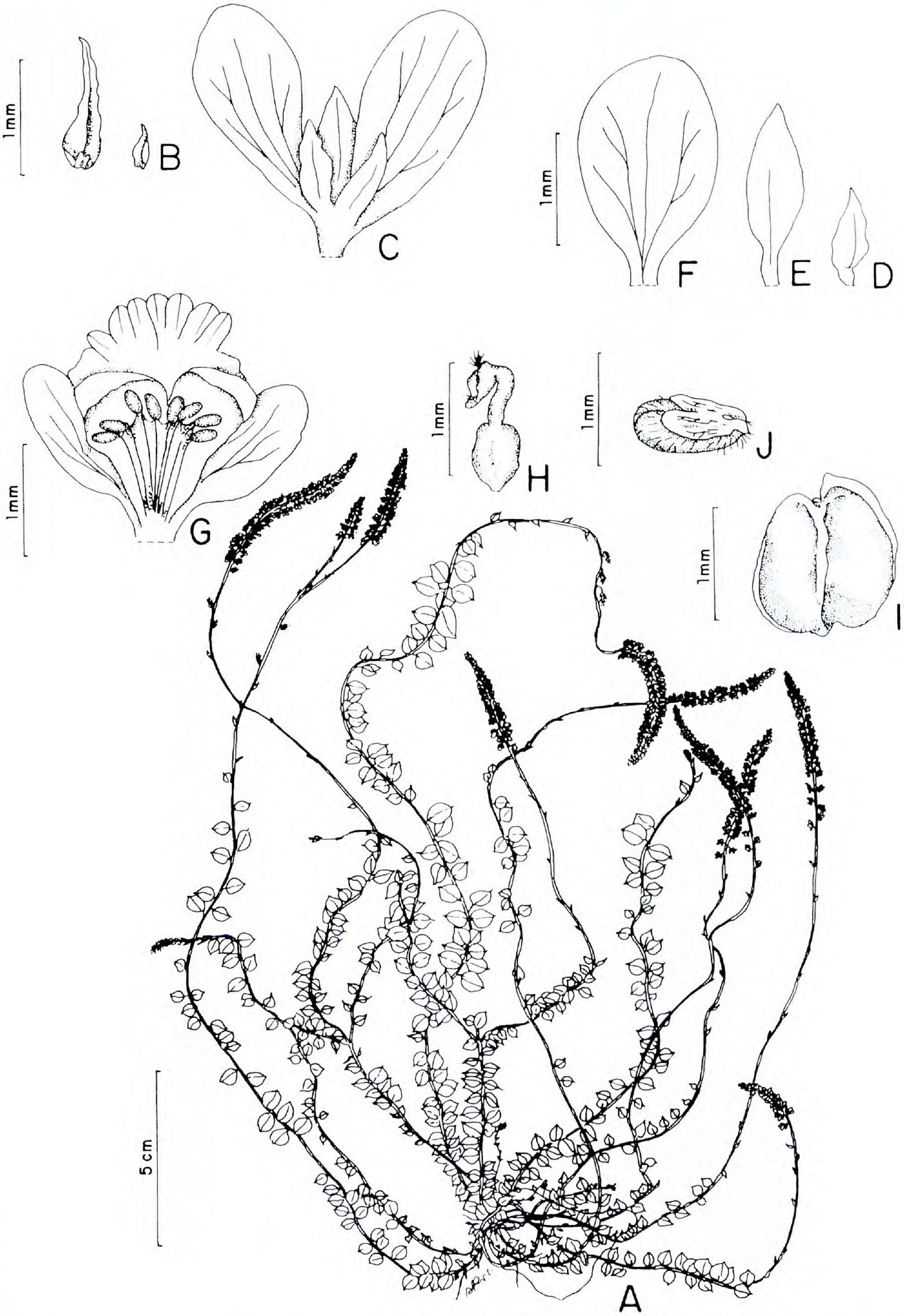

Figure 1. *Polygala riograndensis* Lüdtke & Miotto. —A. Habit. —B. Bract and bracteole. —C. Calyx in lateral view. —D, E. External sepals. —F. Internal sepal. —G. Longitudinal section of corolla and androecium. —H. Gynoecium in longitudinal view. —I. Capsule. —J. Seed. Drawn from the holotype, *R. Lüdtke 190* (ICN).

with one wing more developed; seeds finely pubescent, oblong, 1–1.3 mm, foveolate, lightly reniform, with membranous appendage totally bilobed, ca. 3/4 of seed length.

Phenology. Plants with flowers and fruit occur from September to November.

Etymology. The epithet is derived from Rio Grande do Sul state.

Habitat and distribution. *Polygala riograndensis* has been collected in rocky fields and granite hills, limited to the central region of the Rio Grande do Sul state.

Polygala riograndensis is included in the subgenus *Polygala*, which is recognized by the flowers with crested keel, and is represented by approximately 88 species and 22 varieties in the Brazilian flora (Marques, 1988).

Polygala riograndensis is closely related to *P. campestris*, especially by the resemblance in the habit, the absence of glands, the bracts and bracteoles deciduous, and by the racemes pedunculate and cylindrical. However, *P. riograndensis* is set apart from *P. campestris* mainly by the stems sinuate, capsules winged, leaves petiolate and glabrous, and by the crest of the keel with 6 to 7 lobes that are simple or bifid. All specimens of *P. campestris* collected in the Rio Grande do Sul state present sessile and pilose leaves, the crest of the keel with 8 to 12 simple lobes, and capsules lacking wings. Although both species are present in the Rio Grande do Sul flora, they have a completely different distribution and are not sympatric species. *Polygala campestris* is limited to the high fields of the northeastern region, while *P. riograndensis* occurs only in the rocky fields and granite hills in the central region of the Rio Grande do Sul state.

Paratypes. BRAZIL. **Rio Grande do Sul:** Arroio dos Ratos, Faz. Faxinal, *O. Bueno 3694* (HAS); Canoas, perto de Porto Alegre, *G. A. Malme 128* (S); Encruzilhada do Sul, Est. Exp., 25 Nov. 1972, *A. Pott s.n.* (BLA 8018, ICN 20917); Guaíba, Faz. São Maximiano, BR 116, km 307, 17 Sep. 2006, *E. Freitas s.n.* (ICN 144938); Itaara, Reserva Biol. do Ibicuí-Mirim, Campo dos Barcelos, *M. L. Abruzzi 1840* (HAS), *N. Silveira 6870, 6902* (HAS), *O. Bueno 5661, 6063* (HAS); Lavras do Sul, Mina Volta Grande, *M. Sobral 3121* (ICN); Porto Alegre, *A. Pott 99* (BLA), 8 Sep. 1971, *A. Pott s.n.* (BLA 11120), 18 Sep. 1987, *F. M. S. Vianna s.n.* (ICN 80333); Morro da Polícia, *G. Beneton 76* (HAS), *R. Lüdtke 575* (ICN, K, MO), *R. Lüdtke 577* (ICN), *G. Malme 570* (S), *B. Rambo 27268* (PACA), 27 Oct. 1946, *B. Rambo s.n.* (ICN 16592); Vila Manresa, *B. Rambo 7109, 33847, 38045* (PACA); Viamão, Parque Est. de Itapuã, *J. Mattos & N. Silveira 26963* (HAS).

Acknowledgments. We thank Tarciso Filgueiras for the Latin description, Rafael Trevisan for the help with the figure, and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the financial support of our studies.

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A New Species of *Pecluma* (Pteridophyta–Polypodiaceae)

Olga G. Martínez

Herbario MCNS, Facultad de Ciencias Naturales, Universidad Nacional de Salta, Av. Bolivia 5150, A4400AWE, Salta, Argentina. martinog@unsa.edu.ar

Elías R. de la Sota

Herbario LP, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Paseo del Bosque s.n. B1900FWA, La Plata, Buenos Aires, Argentina. sota@museo.fcnym.unlp.edu.ar

Abstract. A new species of *Pecluma* M. G. Price, *P. barituensis* O. Martínez & de la Sota, is described from material collected from the northwestern forests and mountain woods in Argentina. This taxon is related to *Pecluma oranensis* (de la Sota) de la Sota, from which it differs with its pinnae narrower at mid-rachis, thereby appearing farther apart, and its auriculiform basal pinnae.

Resumen. Se describe y se ilustra una nueva especie de *Pecluma*, *P. barituensis* O. Martínez & de la Sota, sobre material proveniente de las selvas y bosques montanos del noroeste argentino. Este taxón es afín a *Pecluma oranensis* (de la Sota) de la Sota, del que difiere principalmente por sus pinnas medias más delgadas y apareciendo así más distanciadas y las basales auriculiformes.

Key words: Argentina, *Pecluma*, Polypodiaceae.

The genus *Pecluma* M. G. Price (Polypodiaceae) includes more than 30 species that grow in American tropical and subtropical regions. In Argentina, Ponce (1996) quoted eight species, three of which grow in the Argentinean northwest region.

By reviewing Evans's (1969) and Price's (1983) works on the *Polypodium pectinatum-plumula* complex and on *Pecluma* and by floristic studies carried out on the American continents (de la Sota, 1973, 1977, 1995; Tryon & Tryon, 1982; Mickel & Beitel, 1988; Tryon & Stolze, 1993; Moran, 1995; de la Sota & Martínez, 1998; Salino, 1998; Mickel & Smith, 2004; Kessler & Smith, 2005), it is concluded that the specimen described here is a new taxon.

Pecluma barituensis O. Martínez & de la Sota, sp. nov. TYPE: Argentina. Prov. Salta: Dpto. Santa Victoria, Parque Nac. Baritú, 1500 m, 14 July 1999, *O. G. Martínez & E. R. de la Sota 693* (holotype, MCNS; isotype, LP). Figure 1.

Plantae epiphyticae raro terrestres, affines *Peclumae oranensi* (de la Sota) de la Sota sed rhizomate breviter repente, frondibus gracilibus usque ad 70 cm longis, cum segmentis medianis plus angustis et plus distantibus et segmentis basalibus manifeste reductis ad auriculas parvulas, sporis 64, clare verrucosis differunt.

Epiphytic plants, rarely terrestrial; rhizome short-creeping, 3–5 mm diam., with clathrate scales that are deltoid to lanceolate, basifixed, brown, ovate to cordate, with entire margin, with and without trichomes at the back, to 1 cm. Fronds 50–70 cm, petioles 1/5–1/4 of the frond's length, terete, dark brown, articulate to the rhizome, with short phyllopodia, 1–2 mm; laminae elliptic to lanceolate, papyrus-like, slender, pectinate, 40–50 × 8–10 cm, attenuate at the base, gradually attenuate toward the tip; rachis dark, pilose with abundant appressed trichomes, ctenoid, multicellular, 0.3–0.5 mm, denser adaxially; pinnae to 85 pairs; basal pinnae reduced to auricles; pinnae on mid-rachis distant, linear to linear-lanceolate, perpendicular to the rachis, 4–5 × 0.2–0.5 cm, margin entire with hyaline trichomes, lamina with scattered clavate trichomes and setose trichomes over the costae. Lateral veins 1- or 2-forked, with circular superficial sori, 1 mm diam., with receptacles bearing simple or ramified trichomes, as paraphyses; sporangia glabrous; spores 64, spores monolete reniform, clearly verrucose.

Geographic distribution and habitat. The new species is an epiphyte and occasionally terrestrial. It was observed as frequent in forests or humid montane woods, between 1200 and 1500 m, in Salta and Jujuy provinces in northwestern Argentina.

This species had been previously identified in Argentina as *Pecluma oranensis* because both species are found in montane forests or yungas. However, *P. barituensis* can be easily distinguished from *P. oranensis*, as can be seen in Table 1.

In addition, although it is not a diagnostic character, it should be noted that the pinnae are consistently outspread. Usually, in other poikilohydric taxa of this

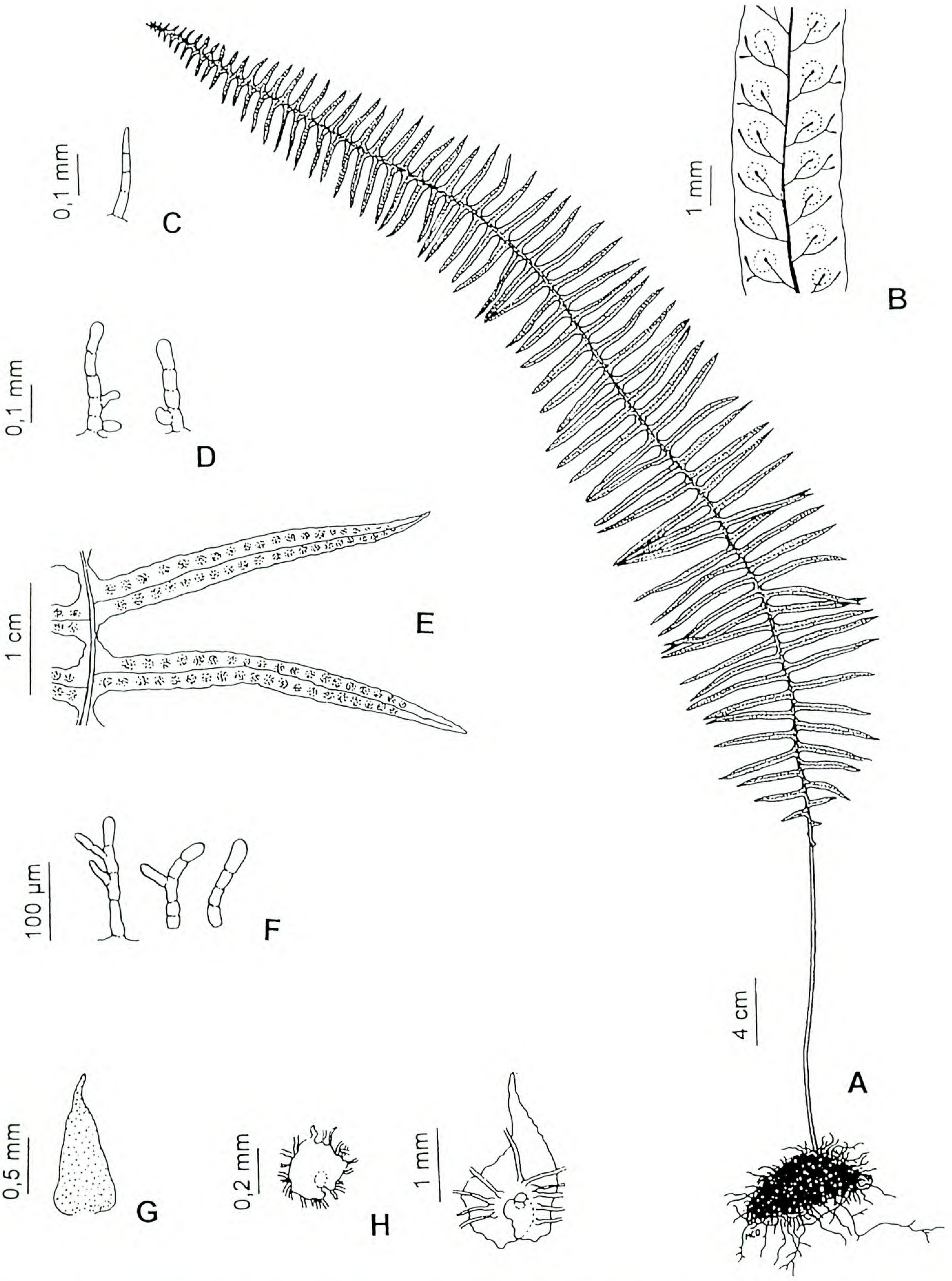

Figure 1. *Pecluma barituensis* O. Martínez & de la Sota. —A. Habit. —B. Close-up of median pinna showing the venation pattern and the sori position. —C. Setose trichome from the rachis. —D. Ctenoid trichomes from the rachis. —E. Pair of pinnae. —F. Simple and ramified trichomes on the sori receptacles. —G. Rhizome scale, drawn without trichomes. —H. Rhizome scales, with trichomes. Drawn from the holotype *O. G. Martínez & E. R. de la Sota 693* (MCNS).

Table 1. Morphological comparison of *Pecluma barituensis* and *P. oranensis*

	P. barituensis	*P. oranensis*
Pinnae on mid-rachis	4–5 × 0.2–0.5 cm	6–7 × 0.6–0.7 cm
Distance between pinnae	usually greater than their width	equal to their width
Basal pinnae	auriculiform	subdilated
Apical pinnae	gradually reduced, 8 to 10 pairs, perpendicular to the rachis	attenuated, 5 to 6 pairs, oblique to the rachis

genus, the pinnae are contracted to reduce the evapotranspirational surfaces, as an adaptation to decreased atmospheric relative humidity.

In this contribution, paraphyses are defined by the criteria given by de la Sota (1986), interpreting the indument of the sori receptacles.

Paratypes. ARGENTINA. **Salta:** Dpto. Anta, Parque Nac. El Rey, Arroyo Quina, *A. Brown 1355* (MCNS); Dpto. Santa Victoria, Parque Nac. Baritú, *O. G. Martínez & V. Aquino 1025* (MCNS), *1028* (MCNS), *1031* (MCNS), *O. G. Martínez, E. R. de la Sota, L. Novara & A. Ganem 685* (MCNS). **Jujuy:** Dpto. Ledesma, Parque Nac. Calilegua, camino a La Mesada y Abra de Cañas, *A. Brown 1714* (MCNS).

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A New Species of *Phacelia* (Hydrophyllaceae) from Southern Arizona, U.S.A.

Steven P. McLaughlin
Office of Arid Lands Studies, University of Arizona, Tucson, Arizona 85721, U.S.A.
spmcl@ag.arizona.edu

Abstract. *Phacelia sonoitensis* S. P. McLaughlin (Hydrophyllaceae) from Santa Cruz County, Arizona, U.S.A., is described and illustrated. The distinctive features of this species are its combination of pinnate leaves and several shallowly cymbiform seeds. The number of seeds per capsule (15 to 30) and seed morphology are not consistent with any currently recognized section of the genus.

Resumen. En este trabajo se describe e ilustra *Phacelia sonoitensis* S. P. McLaughlin (Hydrophyllaceae) del condado de Santa Cruz en Arizona, EE. UU. Las características distintivas son sus hojas pinnadas y varias semillas ligeramente cimbiformes. El número de semillas por cápsula (15 a 30) y la morfología de las semillas no concuerdan con ninguna sección del género reconocida actualmente.

Key words: Arizona, Hydrophyllaceae, *Phacelia*, Sonoita Creek State Natural Area.

There are approximately 150 species of *Phacelia* Jussieu (Hydrophyllaceae); most are from the western United States (Mabberley, 1993), and many are winter annuals of arid and semiarid habitats. Several collections of an unusual *Phacelia* were made as part of a floristic survey of the Sonoita Creek State Natural Area (SCSNA) in Santa Cruz County, southern Arizona, U.S.A., adjacent to the Mexican state of Sonora. These plants have pinnate leaves and 15 to 30 shallowly cymbiform seeds per capsule, a unique combination of character states within the genus.

Phacelia sonoitensis S. P. McLaughlin, sp. nov. TYPE. U.S.A. Arizona: Santa Cruz Co., Sonoita Creek State Natural Area, south-facing rock talus, UTM 12R, E 0506300, N 3486320, 1170 m, 30 Mar. 2001, *S. P. McLaughlin 9123 & B. Lewis* (holotype, ARIZ; isotypes, ASU, MO). Figure 1.

Herbae annuae foliis pinnatis et trichomatibus glandulosis, multicellularibus; sepala anguste spathulata; capsulae oblongae, 5–7 mm longae; semina 15 ad 30, vadoso-cymbiformia.

Annual herbs to 50 cm in height; stems lax, ascending, branched toward the base in robust individuals, sparsely puberulent with longer straight, pustulate-based, unicellular simple trichomes and multicellular glandular trichomes. Leaves mostly cauline, 3–10(–15) cm, pinnate with 5 to 9 sessile or more commonly short-petiolate, toothed to shallowly lobed leaflets, mostly 5–15(–30) × 4–10(–20) mm, pubescent on both surfaces with mostly long, narrow stipitate glandular trichomes. Inflorescence a terminal helicoid cyme at the end of each branch, to 12 cm in fruit. Flowers on pedicels 1–2 mm; calyx glandular and hirsute, lobes narrowly spatulate, 4–6 mm; corolla tubular to narrowly campanulate, 6–8 mm, tube white, lobes blue; stamens included; style 3 mm, branches less than 1 mm. Capsules on pedicels 2–3 mm, oblong, 5–7 mm, calyx in fruit 6–10 mm; seeds 15 to 30, (1–)1.5–2 mm, ovate, thin, shallowly cymbiform with a low central ridge, tessellate-pitted.

Habitat and phenology. Plants of *Phacelia sonoitensis* have been found on the SCSNA in Arizona on talus and rocky slopes at 1140–1250 m elevation in suffrutescent, semiarid plant communities generally mapped as semidesert grasslands. To date the species is known only from the SCSNA, but similar habitat exists in southern Arizona and northern Sonora. Associated species include *Agave schottii* Engelmann, *Eysenhardtia polystachya* (Ortega) Sargent, *Fouquieria splendens* Engelmann, *Plumbago scandens* L., *Erythrina flabelliformis* Kearney, *Prosopis velutina* Wooton, *Sphaeralcea laxa* Wooton & Standley, *Mimosa* L. spp., *Celtis pallida* Torrey, and *Morus microphylla* Buckley. Collections with flowers and fruits have been made in March and April.

Vegetatively, *Phacelia sonoitensis* resembles *P. cryptantha* Greene, a species of northern and central Arizona. Both have pinnate leaves with ovate, shallowly lobed leaflets, multicellular glandular trichomes, and distinctly spatulate calyx lobes. *Phacelia cryptantha* differs from *P. sonoitensis* in its short cymes, hispid calyx lobes, and short, round capsules with just four seeds per capsule, which are pitted but not cymbiform.

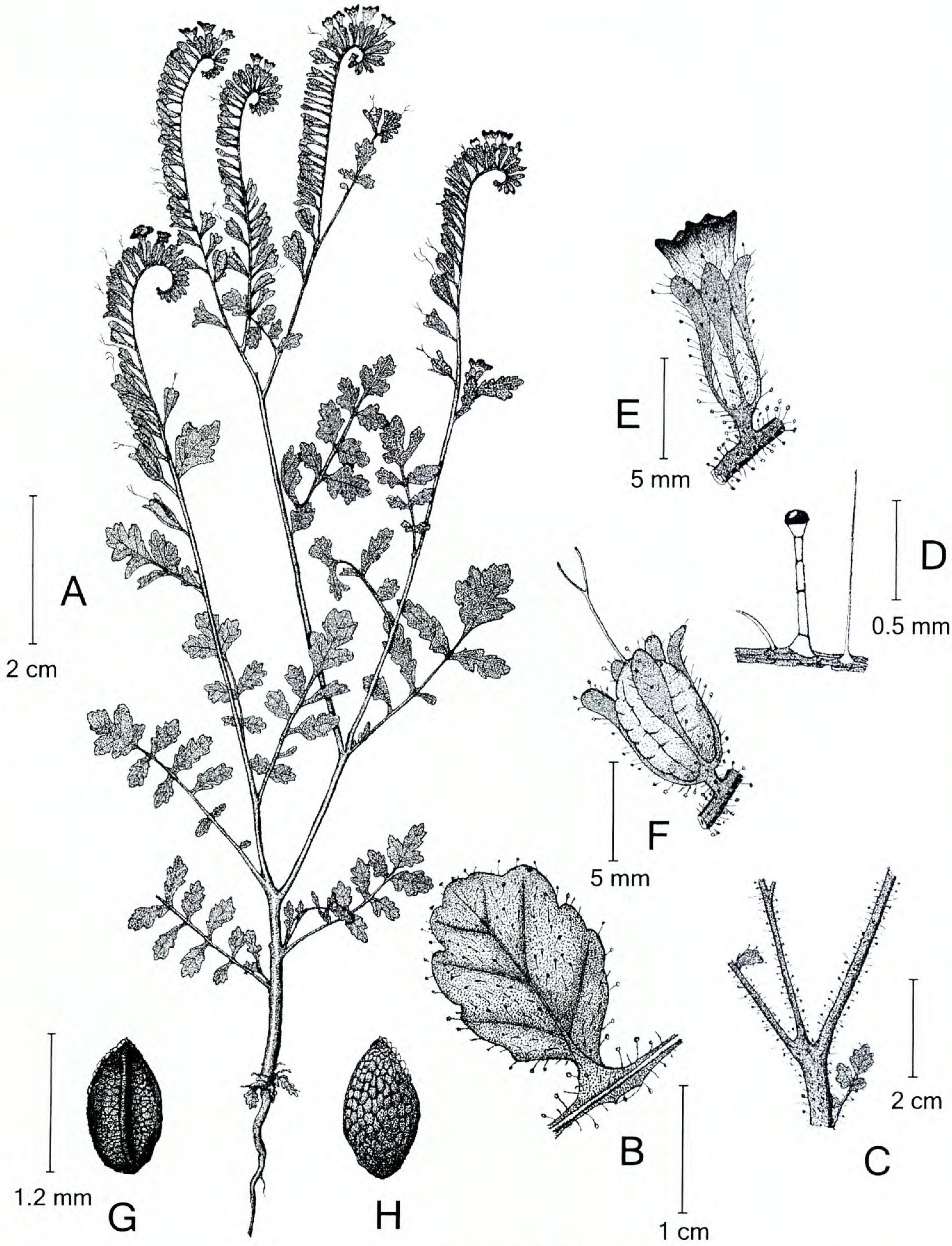

Figure 1. *Phacelia sonoitensis* S. P. McLaughlin. —A. Habit. —B. Leaflet. —C. Stem, showing mixture of trichomes. —D. Detail of trichomes. —E. Flower. —F. Capsule. —G. Seed, ventral view. —H. Seed, dorsal view. Drawn by Philip Jenkins from the holotype, *McLaughlin 9123 & Lewis* (ARIZ).

Five other species of *Phacelia*, all winter annuals, occur at the SCSNA: *P. affinis* A. Gray, *P. arizonica* A. Gray, *P. bombycina* Wooton & Standley, *P. coerulea* Greene, and *P. distans* Bentham. *Phacelia affinis* belongs to section *Euglypta* S. Watson (Howell, 1946), characterized by having numerous small, transversely corrugate seeds. *Phacelia arizonica*, *P. bombycina*, *P. coerulea*, and *P. distans* are all in the *P. crenulata* Torrey ex S. Watson complex (Atwood, 1975) of section *Phacelia*, with just four or fewer

more-or-less cymbiform seeds per capsule that are thin, boat-shaped, and ventrally excavated on either side of a central, longitudinal ventral ridge. Because *P. sonoitensis* has numerous seeds that are shallowly cymbiform, it does not clearly belong to either section *Euglypta* or section *Phacelia*. The species of section *Eutoca* (R. Brown) Brand (Brand, 1913) also have several seeds per capsule, but these are generally more-or-less angled rather than cymbiform. The combination of having more than four cymbiform seeds per capsule apparently is not found in any other species of *Phacelia*.

When I first encountered this plant I thought it might be an intersectional hybrid (F_1) between *Phacelia affinis* and perhaps *P. distans*, although neither of the latter species typically occurs on the rocky slopes favored by *P. sonoitensis*. Through additional fieldwork, however, I found plants of *P. sonoitensis* to have a stable, predictable set of morphological characters that recur in several distinct populations; I found no evidence of segregation of these traits in F_2-like populations.

Paratypes. U.S.A. **Arizona:** Santa Cruz Co., SCSNA, Coal Mine Canyon, on south-facing slope, UTM 12R, E 0508360, N 3486340, 1170 m, 25 Mar. 2001, *S. P. McLaughlin 9088 & B. Lewis, A. Thorne & J. Jordan* (ARIZ, RSA); SCSNA, drainage W of Fresno Canyon, on rocky slope, UTM 12R, E 0506690, N 3486380, 1145 m, *S. P. McLaughlin 9205* (ARIZ, ASU, OSC); SCSNA, near E boundary on rocky east-facing slope, UTM 12R E 0510340, N 3485330, 1240 m, 18 Apr. 2001, *S. P. McLaughlin 9226 & B. Lewis* (ARIZ, BRY).

Acknowledgments. I thank all of those who assisted in looking for this plant in the field, particularly Betsy Lewis, but also George Montgomery, Mills Tandy, Anne Thorne, Jim Jordan, and members of the Arizona Native Plant Society. This species was discovered while working on a project funded by Arizona State Parks. Edward Gilbert helped with the electronic aspects of manuscript submission. Richard Halse provided a very helpful review of an early draft of this manuscript, and Gary Hannan and Duane Atwood provided thorough and critical reviews. Special thanks to Philip Jenkins for his excellent illustration.

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Five New Species of *Jaltomata* (Solanaceae) from Cajamarca, Peru

Thomas Mione
Biology Department, Central Connecticut State University, New Britain, Connecticut 06050-4010, U.S.A. MioneT@ccsu.edu

Segundo Leiva G.
Museo de Historia Natural, Universidad Antenor Orrego, Avenida América Sur 3145, Trujillo, Peru

Leon Yacher
Department of Geography, Southern Connecticut State University, New Haven, Connecticut 06515-1355, U.S.A.

Abstract. Five new suffrutescent to shrubby *Jaltomata* Schlechtendal species (Solanaceae) of the department of Cajamarca, Peru, are described and illustrated. *Jaltomata contumacensis* S. Leiva & Mione has a light green, urceolate-tubular corolla and grows in the province of Contumazá between 2530 and 3000 m; *J. lanata* S. Leiva & Mione has a whitish purple to pale purple, short-tubular corolla and grows in the province of San Pablo between 1850 and 2400 m; *J. leivae* Mione has a red-violet, urceolate corolla containing red nectar and grows in the province of Contumazá between 2560 and 2650 m; *J. oppositifolia* S. Leiva & Mione has a white, broadly infundibular to rotate corolla and grows in province Chota between 2250 and 3090 m; and *J. yacheri* Mione & S. Leiva has a blue-purple, urceolate corolla and grows in province Hualgayoc at 3460 m. The fruits of two of these species are eaten by people.

Key words: Edible fruit, *Jaltomata*, red nectar, Solanaceae.

The species of *Jaltomata* Schlechtendal (Solanaceae) have simple, alternate (often geminate) leaves and 5-merous flowers having five lobes, or 10 if lobules are present. The corolla form is tubular, urceolate, crateriform, campanulate-rotate, or rotate depending on the species. The inflorescence is umbellate or, less commonly, cymose. The ovary has a basal disk, presumably the source of nectar that collects at the base of the corolla. Anthers dehisce longitudinally, and the filament is inserted on the bottom of the ventral face of the anther. The calyx is accrescent but never encloses the berry.

The genus *Jaltomata* includes ca. 50 species of herbs and shrubs, distributed from Arizona in the United States south to Bolivia, as well as in the Greater Antilles (*J. antillana* (Krug & Urban) D'Arcy) and the Galápagos Islands (*J. werffii* D'Arcy). *Jaltomata* can be found throughout Andean Peru to about 4000 m of elevation; northern Peru is the center of diversity. The South American species are nearly all woody, have the full range of corolla forms described above, and nearly all produce orange or red berries. In contrast, the species of Mexico and Central America are herbaceous, have rotate corollas, and produce black or purple berries. In Mexico there are green-fruited morphs of two otherwise blackish purple–fruited species, *J. procumbens* (Cavanilles) J. L. Gentry (Williams, 1985) and *J. chihuahuensis* (Bitter) Mione & Bye (Mione & Bye, 1996).

This paper is a contribution to ongoing taxonomic studies of the genus (Leiva & Mione, 1999; Mione, 1999; Mione & Coe, 1996; Mione et al., 2000, 2004). In the descriptions, structures referred to as glands are 0.07–0.1 mm long and have a unicellular stalk and densely staining multicellular head (Mione & Serazo, 1999: 139). Branchlet hairs "are uniseriate, many-celled and dendroid, with branches emerging at different levels" (Seithe, 1979: 308) and have three or more branches. Forked hairs are also uniseriate and many-celled but have only two termini. Finger hairs are uniseriate and unbranched (Seithe, 1979). Stigmas were measured on pressed specimens, perpendicular to the style. During fieldwork in 1999, we collected the following five new species in the department of Cajamarca, Peru. Three of these were previously described (Leiva, 1998) but until now have not been validly published.

1. Jaltomata contumacensis S. Leiva & Mione, sp. nov. TYPE: Peru. Cajamarca: Prov. Contumazá, Bosque Cachil, betw. Cascas and Contumazá,

2740 m, 16 June 1999, *S. Leiva G., T. Mione & L. Yacher 2356* (holotype, HAO; isotypes, F, MO, USN). Figure 1.

Frutex; laminae ad 8.7 × 5.3 cm, membranaceae, dendritici-piliferae pro maxima parte; inflorescentia 2(3)-flora; corolla urceolata-tubulosa, pallide viridis, limbus 13–17.5 mm, lobis 10; stamina 10–16 mm, antherae 2–2.75 mm; styli 8–21 mm.

Leaning shrub 0.7–4 m high; young axes green, angular, lanate to glabrate with mostly branchlet hairs and some interspersed finger hairs; woody stems to 2.3 cm diam. at base, terete, with lenticels, glabrous, light brown. *Leaves* alternate, often geminate, the blade ovate to lanceolate, membranous, to 8.7 × 5.3 cm, densely to sparsely pubescent on both faces, the apex acute, the base rounded, the margin entire to somewhat repand, ciliate; petiole to 2.1 cm. *Inflorescence* axillary, 2(3)-flowered and fruited; *peduncle* 15(–21) mm; *pedicel* 7–20 mm; both terete, green, and densely to sparsely pubescent with branchlet hairs. *Calyx* green, rotate to somewhat reflexed during anthesis, to 17 mm across, the lobes deltoid, adaxially glabrous, abaxially with a dense covering of mostly branchlet but some finger hairs, the margin ciliate; calyx at fruit maturity to 23 mm across. *Corolla* urceolate-tubular with a broad, slightly recurved 10-lobed limb, light green, the tube 10–11 mm long, abaxially sparsely pubescent with branchlet, finger, and forked hairs and abundant glands, the limb 13–17.5 mm across, with 5 green, narrowly triangular lobes 4 × 2.5 mm alternating with 5 lighter lobules, the margin ciliate; *stamens* 10–16 mm; filaments purple at base (not evident on pressed specimens), otherwise green, pubescent on proximal 20%–40% of the length with simple unpigmented hairs; *anthers* 2–2.75 mm, sometimes mucronate, exserted 1–8 mm beyond the mouth of the corolla; *style* 8–21 mm, pale green; *stigma* capitate, bilobed (often obscured by pressing), green, 0.5–1.1 mm, exserted to 5.8 mm beyond anthers; gynoecium glabrous except for stigma papillae 25–48 µm long; disk broad, girdling base of ovary, the nectar usually translucent, sometimes orange. *Berries* subspherical, orange, to 13 mm across at maturity; *seeds* light brown, 1.38–1.74 × 1.17–1.32 × 0.45–0.54 mm, sub-reniform to sub-orbicular.

Jaltomata contumacensis is similar to *J. yacheri* Mione & S. Leiva (see below) and to *J. biflora* (Ruiz & Pavón) Benítez of the Department of Junín, Peru. *Jaltomata contumacensis* grows to 4 m high, bears predominantly branchlet hairs, and has light-colored anthers and conspicuous corolla lobules. In contrast, *J. biflora* grows to about 1 m high, bears predominantly gland-tipped finger hairs, and has purple anthers and inconspicuous corolla lobules (Mione et al., 2001).

Distribution, ecology, and etymology. *Jaltomata contumacensis* grows in Peru, Department of Cajamarca, province Contumazá, between 2530 and 3000 m. It is abundant along streams and has been collected in the interior of forests. Sagástegui et al. (1995) listed this species among those of Bosque Cachil, a forest fragment. Flowering is in January, and both flowers and fruits were noted in March, April, and June. The specific epithet refers to the province of Contumazá.

Paratypes. PERU. **Cajamarca:** Prov. Contumazá, Bosque Cachil, 13 Apr. 1995, *A. Sagástegui 15570* (F, HAO), 29 Jan. 1996, *S. Leiva G. 1775* (HAO), 16 June 1999, *T. Mione, S. Leiva & L. Yacher 656* (MO); arriba de Bosque Cachil, 28 Jan. 1996, *S. Leiva G. 1762* (F, HAO); alrededores de Bosque Cachil, 28 Jan. 1996, *S. Leiva 1766* (HAO); Ruta Contumazá–Cascabamba, 5 Apr. 1996, *S. Leiva & A. Sagástegui A. 1825* (HAO), 5 Apr. 1996, *S. Leiva & A. Sagástegui A. 1826* (HAO), 28 Mar. 1997, *S. Leiva G., A. Sagástegui A. & V. Quipiscoa 1941* (HAO); Shamon (ca. Cascabamba), 13 Jan. 1996, *A. Sagástegui A. & S. Leiva G. 15832* (HAO); ruta Pampa de La Sal–Lledén, 28 Mar. 1997, *S. Leiva G., A. Sagástegui A. & V. Quipiscoa 1947* (F, HAO); alrededores de San Martín, 29 Mar. 1997, *S. Leiva G., A. Sagástegui A. & V. Quipiscoa 1960* (F, HAO).

2. Jaltomata lanata S. Leiva & Mione, sp. nov. TYPE: Peru. Cajamarca: Prov. San Pablo, Caserío El Sangal, 2220 m, en borde de carr., 18 June 1999, *S. Leiva G., T. Mione & L. Yacher 2365* (holotype, HAO; isotypes, CCSU, CORD, F, HUT). Figure 2.

Frutex vel suffrutex; laminae ad 12.5 × 8 cm, membranaceae, glabrescentes vel piliferae ramosae vel simplices; inflorescentia 4- ad 8(13)-flora; corolla brevitubularis limbo rotato, albida ad pallida purpurea, faux quinque paribus macularum viridium, os tubi annulo purpureo instructum, limbus 7–11 mm, lobis 5; stamina 3.1–4.2 mm, antherae 1.3–1.5 mm; styli 3–4 mm.

Shrub or suffrutescent, 0.80–1.2 m high; young axes angulate, green or brown, sericeous to lanate; woody stems brown, somewhat angular, to 1.5 cm diam. at base, sparsely pubescent to glabrate. *Leaves* alternate, distally geminate, the blade ovate or elliptic, to 12.5 × 8 cm, membranous, both faces glabrescent or pilose with both finger and branchlet hairs, the apex acute, the base rounded, the margin dentate to entire; petiole to 3 cm. *Inflorescence* axillary, 4- to 8(13)-flowered including buds; *peduncle* and *pedicel* both 4–7 mm, terete, green and lanate with both finger and branchlet hairs. *Calyx* green and broadly crateriform during anthesis, 7–8 mm across, the lobes deltoid, abaxially densely villous with branchlet and finger hairs, adaxially glabrous except

Figure 1. *Jaltomata contumacensis* S. Leiva & Mione. —A. Branch with leaves, inflorescences, and fruits. —B. Flower, lateral view. —C. Corolla, dissected to show the insertion of the stamens. —D. Stamen, ventral view. —E. Anther, dorsal view. —F. Anther, lateral view. —G. Gynoecium, including basal disk. —H. Berry with calyx, lateral view. Scale bar of D also applies to E and F. Drawn from *A. Sagástegui et al. 15570* (HAO), by S. Leiva G.

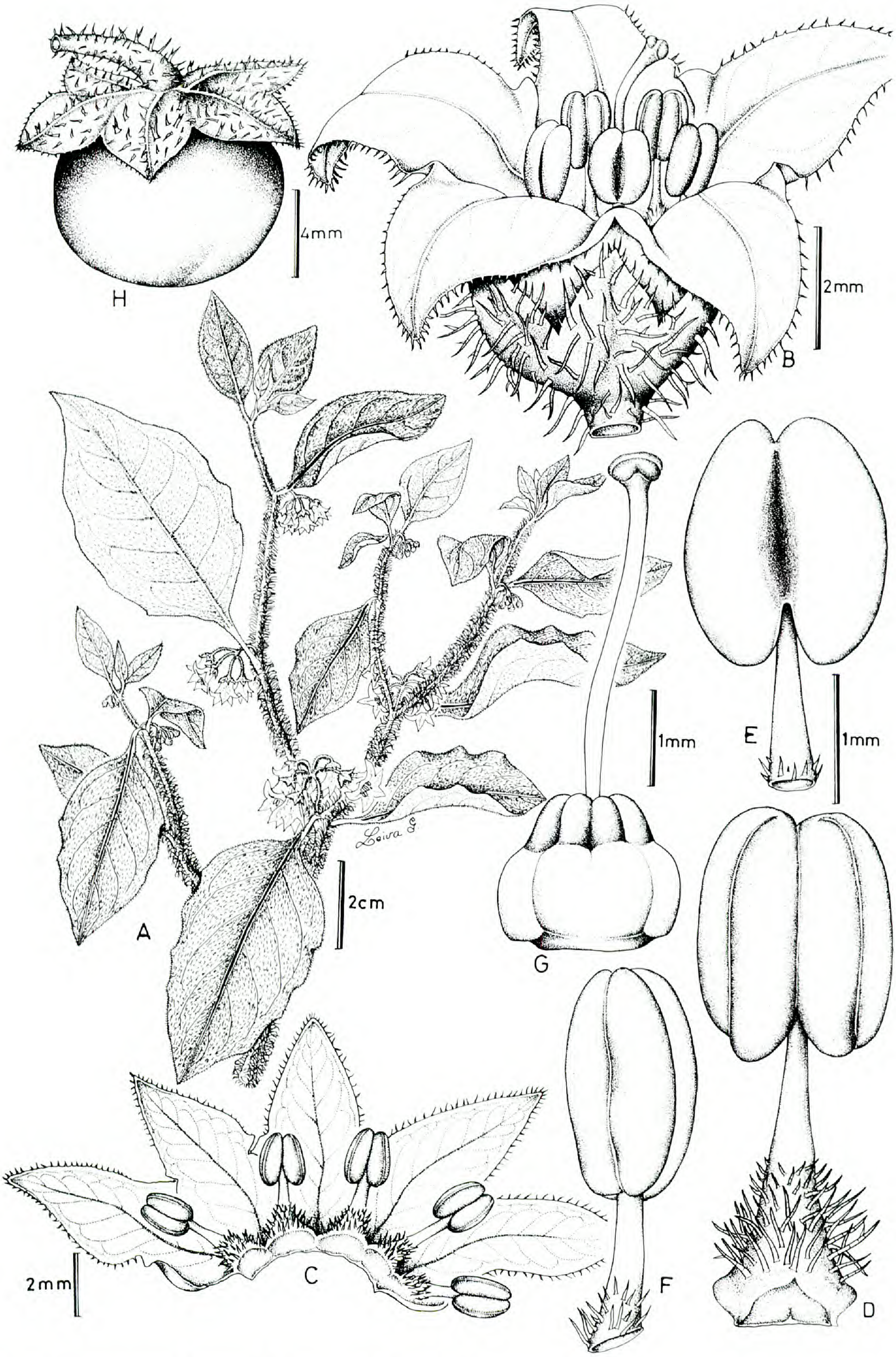

Figure 2. *Jaltomata lanata* S. Leiva & Mione. —A. Branch with leaves and inflorescences. —B. Flower, lateral view. —C. Corolla, dissected to show the insertion of the stamens. —D. Stamen, ventral view. —E, F. Anther with distal portion of filament, dorsal and lateral views, respectively. —G. Gynoecium, including basal disk. —H. Berry with calyx, lateral view. Scale bar of E also applies to D and F. Drawn from *S. Leiva G. 1731* (HAO), by S. Leiva G.

for glands; calyx at fruit maturity green and to 10 mm across; *corolla* short-tubular with a 5-lobed, rotate limb, whitish purple to pale purple, the tube (obscured by pressing) 2.4 × 3.4–3.8 mm, within the tube 2 dark green maculae flank the radial vein extending to the tip of each corolla lobe, narrow purple ring at mouth of tube, the limb lacking lobules, 7–11 mm across, adaxially glabrous, abaxially sparsely pubescent with finger, forked, and branchlet hairs, the margin ciliate; *stamens* 3.1–4.2 mm; *filaments* somewhat purple at base, otherwise off-white, pubescent with unpigmented hairs along 40%–50% of the length; *anthers* yellow, 1.3–1.5 mm, exserted beyond mouth of corolla to 1 mm; *style* 3–4 mm, off-white; *stigma* capitate, bilobed, green, 0.45–0.75 mm, exserted beyond anthers 1.5 mm; gynoecium glabrous except for stigma papillae 30–35 μm long; disk broad, girdling base of ovary. *Berries* subspherical, orange, to 7 × 9 mm at maturity; *seeds* 14 to 21 per berry, brown, alveolate, sub-reniform to sub-triangular, 1.5–1.59 × 1.2–1.29 × 0.45–0.48 mm.

Jaltomata lanata lacks gland-tipped hairs and has a corolla limb 7–11 mm across, stamens 3.1–4.2 mm long, and style 3–4 mm long. In contrast, the species to which it is most similar, *J. hunzikeri* Mione of Peru (Department Lima), is villous with gland-tipped hairs and has a corolla limb 16–17 mm across, stamens 4.8–7 mm long, and style 6–7.7 mm long.

Distribution, ecology, etymology, and uses. *Jaltomata lanata* is known only from Peru, Department Cajamarca, province San Pablo, between 1850 and 2400 m. It grows on roadsides and the edges of agricultural fields. Flowering is in April, May, and June, and fruits were observed in May and June. The specific epithet refers to the lanate young plant axes. The ripe berries have an agreeable flavor and are consumed by people (Leiva, 1998).

Paratypes. PERU. **Cajamarca:** San Pablo, S de San Pablo, 28 May 1994, *S. Leiva G. 1731* (F, HAO); alrededores de San Pablo, 18 June 1994, *A. Sagástegui A., S. Leiva G. & P. Lezama 15373* (F), 14 Apr. 1995, *A. Sagástegui A., S. Leiva G., P. Lezama & R. Veneros 15605* (HAO); Caserío Sangal S de San Pablo, 15 Apr. 1995, *A. Sagástegui A., S. Leiva G., P. Lezama & R. Veneros 15624* (CORD, F, HAO); San Pablo, Sangal–Puente Pucluch, 4 Apr. 1996, *A. Sagástegui A., S. Leiva G. & E. Aquino 15861* (CORD, F, HAO); Caserío El Sangal, 18 June 1999, *T. Mione, S. Leiva G. & L. Yacher 665* (MO).

3. Jaltomata leivae Mione, sp. nov. TYPE: Peru. Cajamarca: Prov. Contumazá, above Guzmango, in remnant patch of native vegetation in ravine along stream, 2650 m, 17 June 1999, *S. Leiva G., T. Mione & L. Yacher 2360* (holotype, HAO; isotypes, CORD, F, MO). Figure 3.

Frutex vel suffrutex; laminae ad 11 × 5.3 cm, membranaceae, glabratae; inflorescentia (1)2(3)-flora; corolla urceolata, basi rubroviolacea limbus totus revolutus, 14 mm latus, lobis 10; stamina 11–14 mm, antherae 1.9–3 mm; styli 9–18 mm.

Suffrutescent or shrub, erect or sometimes leaning, to 2.5 m across when leaning on other vegetation; young axes angulate, green, glabrate with finger or branchlet hairs; woody stems to 2 cm diam. at base, nearly terete, glabrous with lenticels, brown. *Leaves* alternate, often geminate, the blade ovate to elliptical, to 11 × 5.3 cm, membranous, both faces glabrate, the youngest (smallest) leaves with finger or branchlet hairs, the apex acute, the base somewhat attenuate, the margin entire, sparsely ciliolate on older leaves; petiole to 17 mm. *Inflorescence* axillary, (1)2(3)-flowered; *peduncle* 1–9 mm, terete, green; *pedicel* 10–14 mm, terete; both sparsely to densely pubescent with finger and branchlet hairs. Flower buds dome-shaped at the apex and round in cross section. *Calyx* green, recurved at anthesis, 15 mm across, the lobes deltoid, adaxially glabrous except for abundant glands, abaxially pilose with both dentritic and less commonly forked or finger hairs and glands, the margin ciliolate; calyx at fruit maturity 26 mm across; *corolla* urceolate, the tube bright red-violet, glabrous within and 7–9 × 10 mm at base, with 5 cavities filled with red nectar, the abaxial face pilose on veins with branchlet and finger hairs, and abundant glands on the lobes, the limb completely revolute, light blue-purple to off-white, 14 mm across, 10-lobed, the adaxial face pilosulose with finger hairs 0.2–0.3 mm long having a bulbous terminal cell, the margin ciliate; *stamens* 11–14 mm; filaments off-white, pubescent on proximal 20%–25% of length with simple unpigmented hairs; *anthers* yellow prior to dehiscence, 1.9–3 mm, sometimes pubescent near sutures, exserted 6–7 mm beyond the mouth of the corolla; *style* 9–18 mm, green, with a few hairs 0.06 mm long distally; *stigma* capitate, somewhat bilobed, dark green, 0.4 mm, exserted 5.5 mm beyond the anthers and 12 mm beyond the mouth of the corolla, stigma papillae 25–30 μm long; disk broad, girdling base of ovary. *Berries* subspherical, pale orange, to 16 mm diam. at maturity; *seeds* to 168 per berry, sub-triangular to reniform, compressed, alveolate, 1.59–1.8 × 1.23–1.47 × 0.42–0.48 mm.

Jaltomata leivae is similar to *J. ventricosa* (Baker) Mione of the department La Libertad, Peru. Both species have an urceolate corolla having a 10-lobed, revolute limb, abundant red to orange nectar showing through the corolla wall, exserted stamens and style, and a peduncle less than 1 cm long. *Jaltomata leivae* differs by having: (a) flower buds that are dome-shaped at the apex and round in cross section; (b)

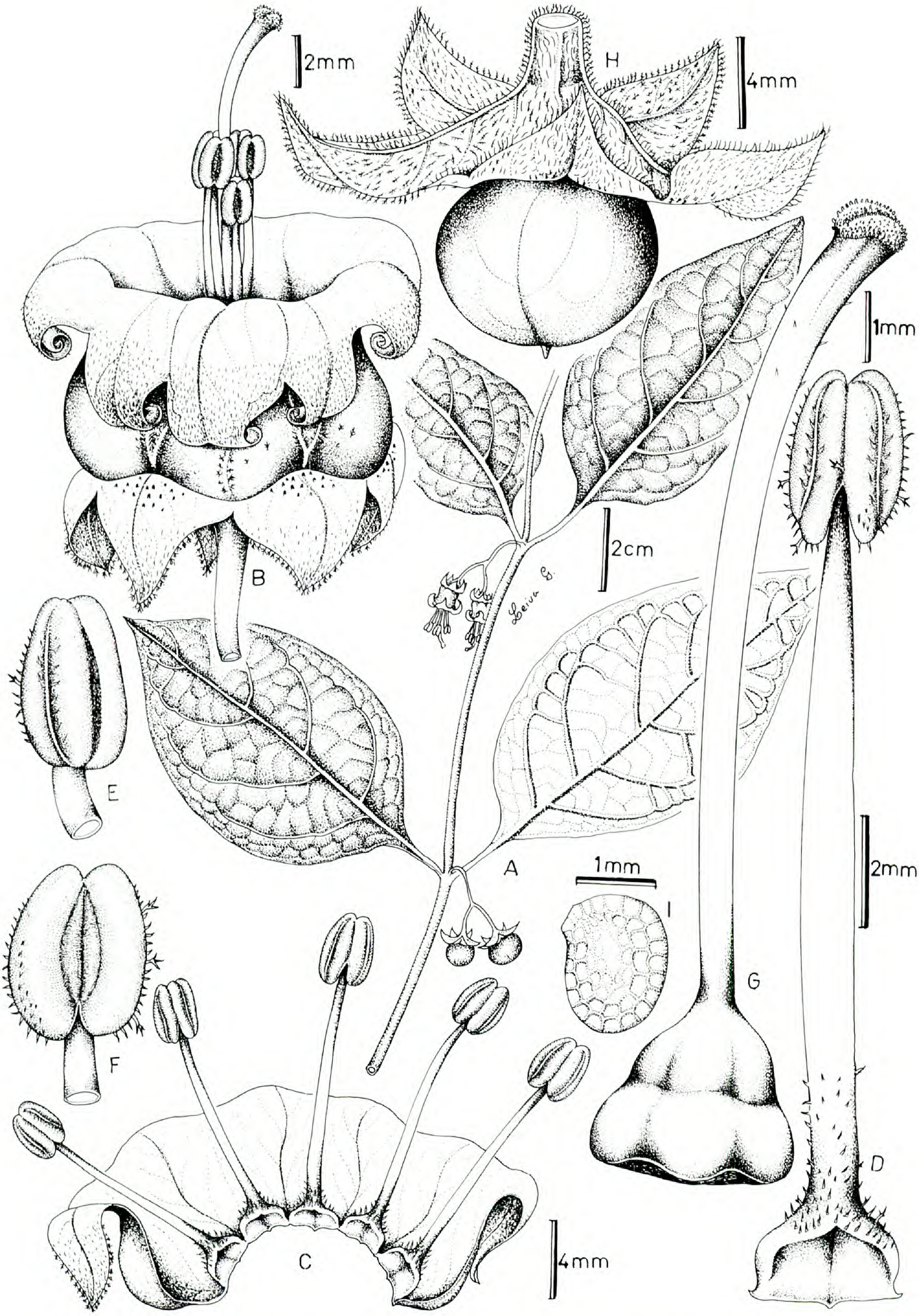

Figure 3. *Jaltomata leivae* Mione. —A. Branch with leaves, inflorescences, and fruits. —B. Flower, lateral view. —C. Corolla, dissected to show the insertion of the stamens. —D. Stamen, ventral view. —E, F. Anther with distal portion of filament, lateral-ventral and dorsal views, respectively. —G. Gynoecium. —H. Berry with calyx, lateral view. Scale bar of D also applies to E and F. Drawn from *S. Leiva G. et al. 2360* (HAO), by S. Leiva G.

calyx lobes deltoid, wider than long, and recurved at anthesis; (c) calyx and corolla abaxially pubescent with branchlet hairs; (d) corolla lobes light blue-purple to off-white; and (e) hairs on no more than 25% of the filament, and hairs often present on the anther. In contrast, *J. ventricosa* has: (a) flower buds pointed at the apex and strongly 5-pointed in cross section; (b) calyx lobes narrowly triangular, longer than wide, and rotate at anthesis; (c) calyx and corolla abaxially glabrate; (d) corolla lobes off-white; and (e) hairs on 37% of the filament, and lacking on the anther.

Distribution, ecology, etymology, and local name. *Jaltomata leivae* is known only from Peru, department Cajamarca, province Contumazá, above the town of Guzmango in a ravine near a stream, between 2560 and 2650 m. This species flowers in April, May, and June, and mature fruit was noted during the type collection (June). The specific epithet was chosen by two of the authors to honor Segundo Leiva G. This species is known locally as "canamuela" (as noted on the specimen sheet *Leiva & Sagástegui 1839*).

Paratypes. PERU. **Cajamarca:** Prov. Contumazá, arriba de Guzmango, 24 Apr. 1995, *S. Leiva G. 1719* (CORD, F, HAO, MO), 31 May 1996, *S. Leiva G. & Sagástegui 1839* (F, HAO); above Guzmango, 17 June 1999, *T. Mione, S. Leiva G. & L. Yacher 660* (MO).

4. Jaltomata oppositifolia S. Leiva & Mione, sp. nov. TYPE: Peru. Cajamarca: Prov. Chota, Bosque el Pargo (betw. Llama & Huambos), 3050 m, 19 June 1999, *S. Leiva G., T. Mione & L. Yacher 2376* (holotype, HAO; isotypes, C, CORD, MO). Figure 4.

Frutex; laminae ad 4 × 1.8 cm, glabrae lucentes; inflorescentia 2(3)-flora; corolla late infundibulari-rotata, alba, faux quinque paribus macularum viridium instructa, 12–13 mm latus, lobis 10; stamina 5–6.5 mm, antherae 1.05–1.65 mm; styli 6.5–8 mm.

Shrub to 1.2 m high, leaning on other vegetation or erect; young axes nearly terete, purple. Woody stems terete, glabrous, to 2 cm diam., brown. *Leaves* usually geminate, the blade elliptic to lanceolate, to 4 × 1.8 cm, lustrous, coriaceous, glabrous, the apex acute, the margin entire and ciliolate; petiole 7–10 mm. *Inflorescence* axillary, with 2 flowers (3 including buds) per inflorescence; *peduncle* 8–17 mm, terete, purple, glabrous; *pedicel* 8–17 mm, somewhat angular, purple, glabrous. *Calyx* green and nearly rotate during anthesis, 6.5–8 mm across, the lobes deltoid, glabrous except for scattered glands on both faces, the margin ciliolate; calyx at fruiting to 17 mm across; *corolla* broadly infundibular to rotate, white with 2 green maculae flanking the radial vein extending to the tip of each lobe, 12–13 mm across, 10-lobed: 5 lobes alternating with 5 lobules, the lobes triangular, adaxially glabrous on herbarium specimens but pilosulose with gland-tipped finger hairs 0.1 mm long on fresh specimens, abaxially with glands, the margin ciliate with finger hairs 0.5 mm long; *stamens* 5–6.5 mm; filaments off-white, pubescent on proximal 55%–70% of the length with unpigmented finger hairs; *anthers* yellow, 1.05–1.65 mm; *style* 6.5–8 mm, off-white; *stigma* capitate, shallowly bilobed (obscured by pressing), green, 0.51–0.84 mm, exserted 2–2.4 mm beyond corolla; *gynoecium* glabrous except for stigma papillae 40 μm long; disk girdling base of ovary. *Berries* subspherical, orange, to 12 mm across at maturity; *seeds* to 106 per fruit, 1.45 × 1.15 × 0.45 mm.

Jaltomata oppositifolia is similar to *J. salpoensis* S. Leiva & Mione. Both species become woody with age; have somewhat small, lustrous, entire leaves, lustrous peduncles and pedicels, and a white corolla; and grow in northern Peru. *Jaltomata oppositifolia* has an upright habit, conspicuous corolla lobules, stamens 5–6.5 mm long, yellow anthers, and style 6.5–8 mm long. *Jaltomata salpoensis*, on the other hand, is prostrate and has a crateriform corolla that lacks lobules, stamens 2.5–3 mm long, white anthers, and style 2 mm long (Leiva & Mione, 1999).

Distribution, ecology, and etymology. *Jaltomata oppositifolia* is known from the type locality and from near the small town of Paraguay, both of Peru, department of Cajamarca, province Chota, between 2250 and 3090 m. This species grows in secondary growth and near streams but is not common. At the type locality it grows at the edge of one of the last remaining old-growth forests we saw in the region. This forest, Bosque El Pargo, was being cut for wood and agriculture when we visited in 1999. This species flowers and fruits in March, May, June, and August. The specific epithet derives from the apparent phyllotaxy.

Paratypes. PERU. **Cajamarca:** Prov. Chota, Bosque el Pargo (betw. Llama & Huambos), 14 Aug. 1994, *S. Leiva G., P. Chuna & J. Cadle 1523* (F, HAO), 18 Mar. 1997, *A. Sagástegui A., S. Leiva G. & V. Quipuzcoa 15996* (HAO), 19 June 1999, *T. Mione, S. Leiva G. & L. Yacher 674* (MO); a 1 km del poblado de Paraguay (betw. Querocoto & La Granja), 7 Aug. 1994, *S. Leiva G., P. Chuna & J. Cadle 1380* (CORD, F, HAO).

5. Jaltomata yacheri Mione & S. Leiva, sp. nov. TYPE: Peru. Cajamarca: Prov. Hualgayoc, near Hualgayoc, 3460 m, 18 June 1999, *T. Mione, S. Leiva G. & L. Yacher 670* (holotype, MO; isotypes, F, HAO). Figure 5.

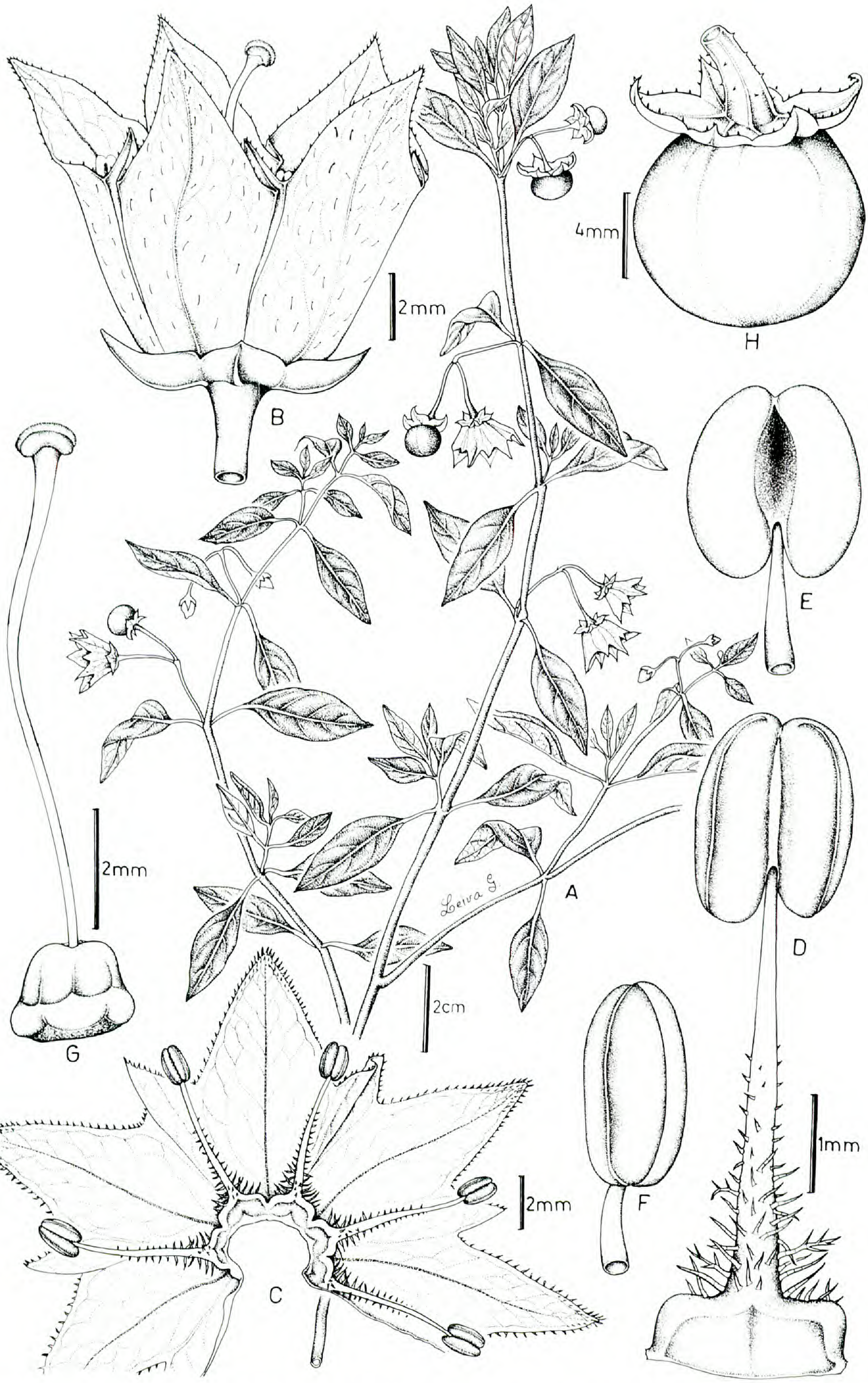

Figure 4. *Jaltomata oppositifolia* S. Leiva & Mione. —A. Branch with leaves, inflorescences, and fruits. —B. Flower, lateral view. —C. Corolla, dissected to show the insertion of the stamens. —D. Stamen, ventral view. —E. Anther, dorsal view. —F. Anther, lateral view. —G. Gynoecium, including the basal disk. —H. Berry with calyx, lateral view. Scale bar of D also applies to E and F. Drawn from *S. Leiva G. et al. 1380* (HAO), by S. Leiva G.

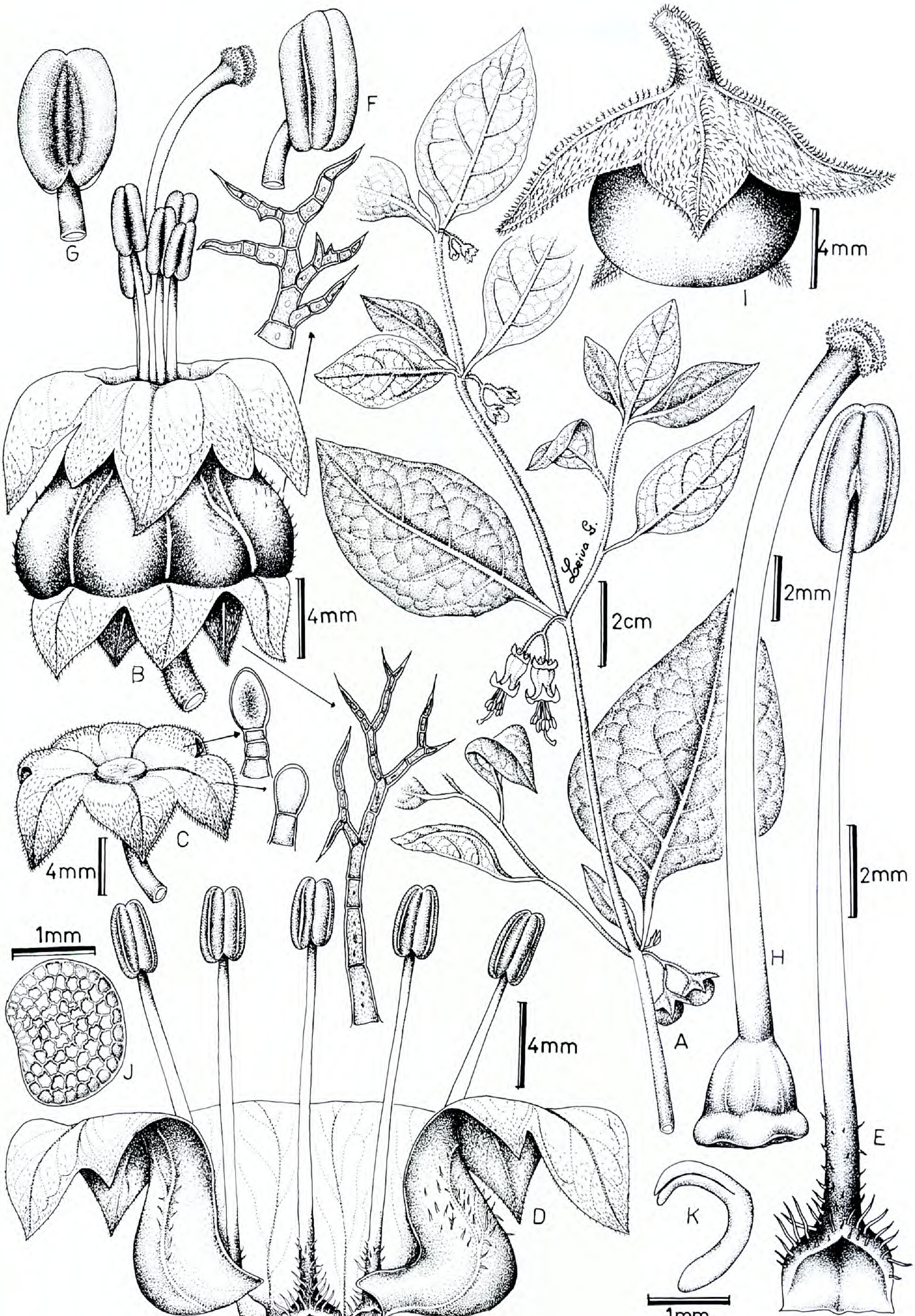

Figure 5. *Jaltomata yacheri* Mione & S. Leiva. —A. Branch with leaves, inflorescences, and fruits. —B. Flower, lateral view. —C. Calyx, oblique view. —D. Corolla, dissected to show the insertion of the stamens. —E. Stamen, ventral view. —F, G. Anther with distal portion of filament, lateral and dorsal views, respectively. —H. Gynoecium, including basal disk. —I. Berry with calyx, lateral view. —J. Seed. —K. Embryo of the seed. Scale bar of E also applies to F and G. Drawn from *S. Leiva G. et al. 2372* (HAO), by S. Leiva G.

Suffrutex; laminae ad 8 × 4.6 cm, aliquantum coriaceae, piliferae simplices vel dendriticae; inflorescentia 2- ad 3(4)-flora; corolla urceolata, cyanea-purpurea, limbus 18–20(–25) mm latus, reflexus, lobis 10; stamina 13–17 mm, antherae 2.4–3.3 mm; styli 1.5–2 cm.

Suffrutescent, to 1.2 m high; young axes pilose and green; woody stems terete, glabrous, green. *Leaves* geminate, the blade ovate, to 8 × 4.6 cm, somewhat coriaceous, abaxially and adaxially pilose with hairs simple to branchlet, the apex acute, the base rounded to somewhat truncate, the margin entire, ciliate; petiole to 1.8 cm. *Inflorescence* axillary or less commonly arising from a stem dichotomy, 2- to 3-flowered (4-flowered including buds); *peduncle* 6–10 mm; *pedicel* 5–10 mm; both terete, green and lanate. *Calyx* green and reflexed at anthesis, to 18 mm across, the lobes triangular, abaxially velutinous with branchlet hairs, adaxially with glands, the margin ciliate; calyx at fruit maturity green and 18–20 mm across; *corolla* urceolate with a reflexed to revolute limb, bright blue-purple, the tube 8–13 mm long, glabrous within, the base 10–12 mm diam., with 5 cavities full of translucent nectar between the expanded bases of the stamens, abaxially with simple, forked, and branchlet hairs mostly on the main veins, the limb 18–20(–25) mm across including lobes, adaxially pilosulose with finger hairs 0.2–0.3 mm, the terminal cell of which is rounded and densely staining, 10-lobed with 5 lobes alternating with 5 lobules, all triangular, the margin ciliate; *stamens* 13–17 mm, varying in length within a flower prior to anther dehiscence; filaments dark purple at base, otherwise pale green, pubescent on proximal 20%–25% of the length with unpigmented simple hairs; *anthers* yellow, 2.4–3.3 mm, exserted 5–14 mm beyond the mouth of the corolla; *style* 1.5–2 cm, pale green; *stigma* capitate, bilobed, green, 0.84–1.5 mm, exserted 8–13 mm beyond the mouth of the corolla; *gynoecium* glabrous except for stigma papillae 60–90 μm long; disk girdling base of ovary, nectar clear. *Berries* subspherical, orange, to 11 mm across at maturity, the style somewhat persistent. *Seeds* 55 to 108 per berry, reniform.

Jaltomata yacheri is similar to *J. contumacensis*. *Jaltomata yacheri* grows to 1.2 m high, has a bright blue-purple corolla, the corolla limb becomes revolute, the calyx is reflexed during anthesis, and the anthers are not mucronate. *Jaltomata contumacensis*, on the other hand, grows to 4 m high (with the support of other plants), has a light green corolla with a slightly recurved limb, the calyx is rotate during anthesis, and the anthers are sometimes mucronate.

Distribution, ecology, etymology, and uses. *Jaltomata yacheri* is known only from Peru, department Cajamarca, province Hualgayoc, in the vicinity of the city of Hualgayoc, where it was locally common on the side of the road at 3460 m. The specific epithet was chosen by T. Mione and S. Leiva G. to honor Dr. Leon Yacher. Three locals told us that the mature berries are consumed uncooked.

Paratype. PERU. **Cajamarca:** Prov. Hualgayoc, near Hualgayoc, 18 June 1999, *S. Leiva G., T. Mione & L. Yacher 2372* (CORD, HAO).

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Isolepis levynsiana, a New Name for *Cyperus tenellus* (Cyperaceae)

A. Muthama Muasya
Botany Department, University of Cape Town, Rondebosch 7701, South Africa.
muthama.muasya@uct.ac.za

David A. Simpson
Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, United Kingdom.
d.simpson@rbgkew.org.uk

Erik Smets
National Herbarium of the Netherlands, P.O. Box 9514, NL-2300 RA Leiden, Netherlands; and Laboratory of Plant Systematics, K.U. Leuven, Kasteelpark Arenberg 31, BE-3001 Leuven, Belgium. smets@nhn.leidenuniv.nl

Abstract. The recently published name *Isolepis tenella* (L. f) Muasya & D. A. Simpson is illegitimate, because there exists an earlier homonym. A new name, *I. levynsiana* Muasya & D. A. Simpson, is proposed for *Cyperus tenellus*.

Key words: Cyperaceae, *Cyperus*, *Isolepis*.

We recently proposed a new combination (Muasya et al., 2006), *Isolepis tenella* (L. f) Muasya & D. A. Simpson for the annual *Cyperus tenellus* L. f. However, an earlier homonym *I. tenella* (Link) Kunth (Kunth, 1837) exists, referring to the Brazilian *Fimbristylis tenella* (Link) Schultes, and therefore the later homonym is illegitimate. A new name, *I. levynsiana* Muasya & D. A. Simpson, is proposed. The name honors Dr. Margaret Levyns (1890–1975), who was based at the University of Cape Town and whose research forms a vital foundation on the Cyperaceae in the Cape Floristic Region.

Isolepis levynsiana Muasya & D. A. Simpson, nom. nov. Replaced name: *Cyperus tenellus* L. f., Suppl. Pl.: 103. 1782. *Isolepis tenella* (L. f.) Muasya & D. A. Simpson, Novon 16: 89. 2006, nom. illegit., non *Isolepis tenella* (Link) Kunth, 1837. TYPE: South Africa, *Linnean Herbarium no. 71/2* (lectotype, designated by Muasya et al., 2006: 89, LINN).

Acknowledgment. We thank Gerrit Davidse for pointing out the earlier homonym.

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New Species of *Stachys* (Lamiaceae) from Mesoamerica

Amy Pool
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
amy.pool@mobot.org

Abstract. Four new species of *Stachys* L. from Mesoamerica, *S. darcyana* A. Pool, *S. harleyana* A. Pool, *S. riparia* A. Pool, and *S. uniflora* A. Pool, are described and their relationships with allied species are discussed. The new species are similar to each other in having stems rooting only at the lower nodes and corollas of various shades of pink or purple with the corolla tubes of medium size, 3.8–8 mm long. *Stachys darcyana* (Costa Rica and Panama) and *S. harleyana* (Chiapas, Mexico) have relatively large upper corolla lips (2.5–5 mm long) and the stamens exserted from the corolla tube 2.1–3.5 mm; the verticillasters in *S. darcyana* are 8- to 12-flowered and in *S. harleyana* 4- to 8-flowered. *Stachys riparia* (Costa Rica) and *S. uniflora* (Costa Rica and Panama) have relatively small upper corolla lips (1.1–2.25 mm long) and the stamens exserted from the corolla tube 0.5–1.25 mm; the verticillasters in *S. riparia* are 6- to 12-flowered and in *S. uniflora* the flowers are solitary in the axils of the leaves.

Resumen. Se describen cuatro especies nuevas de *Stachys* L. de Mesoamérica, *S. darcyana* A. Pool, *S. harleyana* A. Pool, *S. riparia* A. Pool y *S. uniflora* A. Pool, y se discute sus relaciones con especies aliadas. Las especies nuevas son similares entre sí por tener tallos que enraízan sólo en los nudos inferiores y corolas de varias gamas de rosa o purpúreo con los tubos corolinos de tamaño mediano, 3.8–8 mm de largo. *Stachys darcyana* (Costa Rica y Panamá) y *S. harleyana* (Chiapas, México) tienen los labios corolinos superiores relativamente largos, 2.5–5 mm de largo y los estambres exertos 2.1–3.5 mm del tubo corolino; los verticilastros en *S. darcyana* tienen de 8 a 12 flores y en *S. harleyana* de 4 a 8 flores. *Stachys riparia* (Costa Rica) y *S. uniflora* (Costa Rica y Panamá) tienen los labios superiores corolinos relativamente pequeños (1.1–2.25 mm de largo) y los estambres exertos 0.5–1.25 mm del tubo corolino; los verticilastros en *S. riparia* tienen de 6 a 12 flores y en *S. uniflora* las flores son solitarias en las axilas de las hojas.

Key words: IUCN Red List, Lamiaceae, Mesoamerica, *Stachys*.

Stachys L. is a subcosmopolitan genus in the Lamiaceae of approximately 275 species with primary centers of diversity in the warm temperate regions of the Mediterranean and Southwest Asia, and with secondary centers in North America, South America, and southern Africa (Bhattacharjee, 1980). Epling (1934) provided a preliminary revision of the American species in which he recognized 27 species from Mexico and Central America, with seven species from the Mesoamerican region, *S. agraria* Schlechtendal & Chamisso, *S. coccinea* Ortega (as *S. coccinea* Jacquin, Turner 1994a), *S. costaricensis* Briquet, *S. guatemalensis* Epling, *S. lindenii* Bentham, *S. nubilorum* Epling, and *S. pittieri* Briquet. In a subsequent paper (1944), Epling described two new Mesoamerican species, *S. calcicola* and *S. glechomoides*, and expanded the geographic range of two species, *S. eriantha* Bentham and *S. radicans* Epling, to Mesoamerica, and in 1966, in conjunction with Játiva, placed one of his Mesoamerican species, *S. guatemalensis*, in synonymy with *S. rotundifolia* Mociño & Sessé ex Bentham. Recent Mesoamerican floristic treatments of *Stachys*, *Flora of Costa Rica* (Standley, 1938), *Flora of Panama* (Nowicke & Epling, 1969), and *Flora de Nicaragua* (Pool, 2001), have followed the species concepts of Epling (1934). In the *Flora of Guatemala*, Standley and Williams (1973) followed Epling (1934) with the addition of *S. calcicola*, but placed *S. glechomoides* in synonymy of *S. guatemalensis*, and did not include *S. eriantha* and *S. radicans*, cited in Epling (1944) as occurring in Guatemala.

Turner (1994b) published a synopsis of the Mexican and Central American species in which he recognized 38 species with 9 species from the Mesoamerica region, *Stachys agraria*, *S. calcicola*, *S. coccinea*, *S. lindenii*, *S. nubilorum*, *S. pilosissima* M. Martens & Galeotti, *S. pittieri*, *S. radicans*, and *S. rotundifolia*. His treatment of Mesoamerican species concurred with that of Epling (1934, 1944), excluding his treatment of *S. costaricensis*, *S. glechomoides*, and *S. guatemalensis*, all of which he placed in synonymy of *S. pilosissima*.

Pool (in an upcoming volume of *Flora Mesoamericana*) recognizes 12 species of *Stachys* for Mesoamerica, *Stachys agraria*, *S. calcicola*, *S. coccinea*, *S. costaricensis* (including *S. guatemalensis*), *S. lindenii*, *S. nubilorum* (including *S. glechomoides*), *S. pittieri*, and *S. rotundifolia*, in addition to the four new species published here. Two of the new species, *S. riparia* A.

Pool and *S. uniflora* A. Pool, have very short upper corolla lips and can be identified as *S. pittieri* using the keys of Epling (1934) and Turner (1994b). In the *Flora de Nicaragua*, Pool (2001) treated the unpublished species, *S. riparia* and *S. uniflora*, in discussion as *S. fendleri* Briquet. Numerous specimens of the new species *Stachys harleyana* A. Pool, which has narrowly oblong to elliptic-oblong leaves, have been identified as *S. radicans* by Epling and/or Turner, and the new species can be identified as this in their keys (Epling, 1934; Turner, 1994b), if habit is ignored. *Stachys darcyana* A. Pool could probably be identified as *S. pilosissima* following Turner (1994b), but with 8 to 12 flowers per node versus 4 to 6, or following Epling (1934) as *S. costaricensis*, again ignoring habit. A full key to the Mesoamerican species of *Stachys* will be published as part of the *Flora Mesoamericana* treatment (Pool, ined.).

The cyme is the basic unit of the inflorescence in the Lamiaceae. Often the peduncle of the cyme is greatly reduced resulting in a congested fascicle of flowers. An opposite pair of such cymose fascicles is referred to by most students of the Lamiaceae (Bentham, 1832–1836; Harley, 2004) and here, as a verticillaster. This is opposed to the use of this term in the *Flora of Panama* (Nowicke & Epling, 1969), in which the cyme is termed a verticillaster and the pair of cymes a verticil.

1. Stachys darcyana A. Pool, sp. nov. TYPE: Panama. Chiriquí: from center of town to top of Barú, 18 km from Boquete, *J. P. Folsom, W. D'Arcy & L. Skog 2264* (holotype, MO). Figure 1.

Species nova *Stachydi sprucei* Briquet similis, sed ab ea foliorum lanceolatorum apice acuminato et margine crenulato differt.

Perennial (?) herbs, over 0.6 m, lax, probably rooting only near base, pubescent, the indumentum glandular-capitate hairs, 0.05–0.25 mm, spreading, and eglandular hairs, coarse, 1–1.5 × 0.05 mm, tangled or spreading, and fine, 0.05–1.5 mm, tangled to spreading. Vegetative leaves 2.1–9.5 × 1.2–6.1 cm, lanceolate, adaxial surface with hairs 0.25–1 mm, abundant, abaxial surface with hairs 0.25–1 mm, abundant, the base cordate and shortly cuneate, the margins finely crenate, the apex acuminate; petioles 1–4.5 cm. Verticillasters 8- to 12-flowered, usually contiguous distally to form a thick, terminal spike-like inflorescence, proximally further spaced, the upper subtended by narrowly oblanceolate, basally broadly attenuate bracts; pedicels 0.75–2.25 mm; bracteoles 0.5–1.25 mm. Flowering calyces 5–7 mm, 3/4 to equaling length of corolla tube, pubescent with hairs 0.04–0.4 mm, the tube 2.75–4.5 × 1.5–2.25 mm, cylindric, the teeth 2.25–3.25 mm, 2/5 to nearly 1/2 length of calyx, narrowly lanceolate, subcoriaceous, erect, apices acuminate with rigid spine-like tips; corollas pink-lavender to mauve, the tube 6–8 × 1.5–3 mm, 2/5 to slightly over 1/2 exserted from calyx tube, equaling to 1/4 exserted from total calyx, with annulus 1.75–3.25 mm above base, not saccate, the lower lip 4–7 mm, 2/3 to equaling length of corolla tube, middle lobe 1.5–3.5 mm, lateral lobes 1–1.5 mm, the upper lip 2.5–3.75 × 2.25–3.25 mm, 2/5 to 3/5 length of lower lip and forming 90°–180° angle with lower lip, obtuse and bifid; stamens exserted from corolla tube 2.2–3 mm; style exserted from tube 2–3.5 mm. Nutlets 1.6–1.75 × 1.4–1.5 mm, dark red-brown.

Distribution. *Stachys darcyana* is endemic to central Costa Rica and northern Panama, where it is found in high montane forests, between 3000 and 3300 m elevation.

Conservation status. At this time the conservation status of *Stachys darcyana* is estimated to be Endangered (EN B1 a) (IUCN, 2001), as the extent of occurrence is estimated to be less than 5000 km^2 and there are less than five known localities. A search for this species might result in its status being lowered.

Stachys darcyana is most similar vegetatively to *S. hebens* Epling (Colombia), which differs in having only four or six flowers per verticillaster, the verticillasters distant, corollas tubes saccate, and the upper corolla lips 3.75–5.5 mm long. *Stachys sprucei* Briquet (Ecuador) is similar to *S. darcyana* in its inflorescence and flowers, but has leaves that are oblong to broadly ovate, with broadly rounded apices, and margins broadly crenate. *Stachys darcyana* could probably be misidentified as *S. pilosissima* following Turner (1994b), but with more flowers per node, or following Epling (1934) as *S. costaricensis*, ignoring habit. *Stachys pilosissima* (Mexico) differs from *S. darcyana* in its rounded to bluntly acute leaf apices, verticillasters with only four to six flowers subtended by reduced floral leaves, and the corolla tubes 1/4 to 2/5 exserted from the calyx. *Stachys costaricensis* (Mexico to Panama) differs from *S. darcyana* by its 2- to 6-flowered verticillasters, saccate corolla tubes, and relatively longer upper corolla lips, which are 3/5 to slightly longer than the lower lips.

Paratypes. COSTA RICA. **San José-Cartago:** Cordillera de Talamanca, upper slopes, W ridge of Cerros Cuericí, 15 Sep. 1983, *G. Davidse 24673* (MO). PANAMA. **Chiriquí:** La Nevera, below summit of El Barú, 14 Mar. 1979, *W. D'Arcy & B. Hammel 12471* (K not seen, MO), *W. D'Arcy & B. Hammel 12472* (K not seen, MO); S of Paso Respingo trail to high ridge N of Volcán Barú summit, 4 Apr. 1979, *B. Hammel, W. D'Arcy, E. C. Hill, S. Schwartz, O. & H. Wolcott 6719* (MO).

Figure 1. *Stachys darcyana* A. Pool. —A. Habit. —B. Inflorescence (*J. P. Folsom, W. D'Arcy & L. Skog 2264* (MO), holotype).

Figure 2. *Stachys harleyana* A. Pool. —A. Habit. —B. Verticillaster (*D. E. Breedlove 51924* (CAS), isotype).

2. Stachys harleyana A. Pool, sp. nov. TYPE: Mexico. Chiapas: Mun. de San Cristóbal de las Casas, E edge of San Cristóbal de las Casas on slopes along Río Amarillo, 2195 m, 4 Aug. 1981, *D. E. Breedlove 51924* (holotype, MO; isotypes, CAS, MEXU). Figure 2.

Species nova *Stachydi radicanti* Epling similis, sed ab ea caulibus glabriusculis e nodis infimis tantum radicantibus, verticillastrorum bracteis (e foliis caulinis discrepantibus) subtentis atque calycis dentibus ad apicem attenuatis differt.

Perennial herbs, 0.2–0.5 m, decumbent and rooting only at lower nodes, upper nodes and inflorescence erect, nearly glabrous, the indumentum a mixture of glandular-capitate hairs, 0.05–0.15 mm, spreading, and eglandular hairs, 0.05–0.25 mm, spreading to tangled. Vegetative leaves 0.9–3.1 × 0.4–1.2 cm, narrowly oblong to elliptic-oblong, adaxial surface with hairs 0.05–0.5 mm, scattered, or glabrous, abaxial surface glabrous (rarely with hairs 0.05–0.1 mm), the base truncate or rounded, then decurrent along petiole, the margins serrulate, the apex rounded to bluntly acute; petioles 0.2–0.5 cm. Verticillasters 4- to 8-flowered, all well spaced, or closer distally, the upper subtended by narrowly elliptic, sessile, or basally broadly attenuate bracts; pedicels 0.25–1 mm; bracteoles 0.5–1 mm. Flowering calyces 4–4.75 mm, 7/10 to equaling length of corolla tube, pubescent with hairs 0.05–0.5 mm, the tube 2.25–2.75 × 1.5–2.25 mm, campanulate, the teeth 1.5–2.25 mm, ca. 2/5 to 1/2 length of calyx, lanceolate, membranaceous, erect to weakly curving and spreading, apices acuminate with pointed, often curved tips, if spine-like then fragile; corollas pink-purple, the tube 4–6 × 1.4–2.5 mm, 2/5 to 3/5 exserted from calyx tube, equaling to 3/10 exserted from total calyx, with annulus 1.5–3 mm above base, not or only slightly saccate above annulus, the lower lip 4.25–6 mm, 9/10 length of to slightly longer than corolla tube, middle lobe 1.6–3.5 mm, lateral lobes 0.6–1.75 mm, the upper lip 3.25–5 × 2–3.25 mm, 2/3 to equaling length of lower lip and forming 90° angle with lower lip, truncate and bifid; stamens exserted from corolla tube 2.1–3.5 mm; style exserted from tube 1–3 mm. Nutlets 1.75 × 1–1.25 mm, red-brown.

Distribution. *Stachys harleyana* is endemic to central Chiapas, where it is found in wet pastures or mixed forest with oak, between 2000 and 2200 m elevation.

Conservation status. At this time the conservation status of *Stachys harleyana* is estimated to be Endangered (EN B1 a) (IUCN, 2001), as the extent of occurrence is estimated to be less than 5000 km^2 and there are less than five known localities. A search for this species might result in its status being lowered.

Stachys harleyana is similar to *S. radicans* (central Mexico), which differs in habit, rooting from all but the most apical nodes, usually broader leaves (length less than or equal to two times width), pilose stems, pubescent abaxial leaf surfaces, closely condensed verticillasters subtended by floral leaves no different from the vegetative leaves, and deltoid and apically

obtuse to acute calyx teeth. The flowers of *S. harleyana* are very similar to those of *S. costaricensis*. The latter differs in habit, usually rooting from numerous nodes (vs. only the lower), leaves broader and cordate with longer petioles, and the leaves and stems much more densely pubescent than those of *S. harleyana*. This species is named in honor of R. M. Harley, who first annotated *Brenan et al. 14423* (K, MEXU) as perhaps representing a new species.

Paratypes. MEXICO. 1864–1870, *Ghiesbreght 744* (MO). **Chiapas:** San Cristóbal de las Casas, in wet pasture betw. town & Hotel Molino de Alborada, 28 Oct. 1977, *J. P. M. Brenan, E. W. & M. Greenwood 14423* (K, MEXU); along Tuxtla Gutiérrez–Comitán hwy. (Mexico 190), ca. 1 mi. (1.5 km) E of San Cristóbal de las Casas, 12 July 1974, *R. Sanders 74126* (K, MEXU, NY); cult. at Univ. of Michigan, Matthaei Botanical Gardens from *R. Sanders 74126*, *R. Sanders s.n.* (NY); N end San Cristóbal de las Casas, 6 July 1964, *D. E. Breedlove 6024* (DS at CAS); San Cristóbal de las Casas, Cerro San Cristóbal, 18 Aug. 1965, *D. E. Breedlove 11898* (DS at CAS, F); Mun. of Zinacantán, valley floor of Zinacantán Center, 13 Apr. 1966, *R. M. Laughlin 665* (DS at CAS, MEXU), 27 May 1966, *R. M. Laughlin 986* (DS at CAS, US); Mun. of Tenejapa, slopes W Tenejapa Center along trail to Paraiso, 5 Aug. 1964, *D. E. Breedlove 6871* (DS at CAS, F); Mun. of Tenejapa, steep moist slope of sumidero in Tenejapa Center, 11 July 1965, *D. E. Breedlove 10744* (DS at CAS); Mun. of Tenejapa, slope along trail from Tenejapa Center to Colonia San Antonio, 12 July 1965, *D. E. Breedlove 10787* (DS at CAS, MEXU).

3. Stachys riparia A. Pool, sp. nov. TYPE: Costa Rica. Limón: Cordillera de Talamanca, Cantón de Talamanca, along side of Río Lori (tributary of Río Coen), just upstream from mouth of Quebrada Kuisa, 9°21′30″N, 83°13′30″W, 1810 m, 19 Mar. 1993, *M. Grayum 10364* (holotype, MO; isotype, INB not seen). Figure 3B.

Species nova *Stachydi pittieri* Briquet similis, sed ab ea calycibus minoribus, calyce longitudine corollae tubi 3/5–2/3 partes aequanti, calycis dentibus obtusis in acumene debile desinenti atque verticillastris 6- a 12-floris differt.

Perennial herbs, ca. 0.5 m, decumbent and rooting only at lower nodes, pubescent, the indumentum a mixture of glandular-capitate hairs, 0.05–0.6 mm, tangled to spreading, and eglandular hairs, coarse, 0.75–2.5 × 0.05 mm, spreading to tangled, and fine, 0.05–0.5 mm, spreading to tangled. Vegetative leaves 2.6–3.1 × 1.6–2.1 cm, lanceolate, adaxial surface with hairs 0.3–2 mm, abundant, abaxial surface with hairs 0.5–2 mm, abundant, the base cordate and shortly cuneate to subtruncate, the margins crenate, the apex acute or blunt acute; petioles 0.6–2 cm. Verticillasters 6- to 12-flowered, well spaced, the upper subtended by reduced, petiolate floral leaves; pedicels 1.5–1.75 mm; bracteoles 0.5–1 mm. Flowering calyces 2.6–3.1 mm, 3/5 to 2/3 length of corolla tube, nearly glabrous with few hairs 0.25–1 mm, the tube 1.76–2.25 × 1.25 mm, narrowly obconic with swollen base, the teeth 0.75–0.9 mm, less than 1/3 length of calyx, deltoid, membranaceous, erect, apices obtuse with weak, minute acumen; corollas magenta-pink, the tube 3.8–5.2 × 1–1.25 mm, 1/2 to 3/5 exserted from calyx tube, 1/3 to 2/5 exserted from total calyx, with annulus 1.5–2.6 mm above base, not saccate, the lower lip 2.25–3.8 mm, 1/2 to 3/4 length of corolla tube, middle lobe 0.8–1.8 mm, lateral lobes 0.5–0.6 mm, the upper lip 1.1–1.5 × 1.4–1.5 mm, 2/5 to 7/10 length of lower lip and forming 45° angle with lower lip, obtuse to slightly bifid; stamens exserted from corolla tube 0.75–1 mm; style exserted from tube 0.5–1.5 mm. Nutlets 1.3 × 1.1 mm, brown.

Distribution. *Stachys riparia* is endemic to the Cordillera de Talamanca in Costa Rica, where it is found along rivers, between 1400 and 1810 m elevation.

Conservation status. At this time the conservation status of *Stachys riparia* is estimated to be Endangered (EN B1 a) (IUCN, 2001), as the extent of occurrence is estimated to be less than 5000 km² and there are less than five known localities. A search for this species might result in its status being lowered. Conversely, a broad definition of location might raise the status to Critically Endangered (CR B1a), as the extent of occurrence is estimated to be less than 100 km².

The flowers of *Stachys riparia* are similar to those of *S. uniflora* (described below), *S. pittieri*, and *S. fendleri* in having corollas with a relatively small upper lip and the stamens only slightly exserted from the corolla tube. *Stachys pittieri* differs from *S. riparia* in having verticillasters with only four or six flowers and flowers with larger, densely pubescent calyces, with the teeth lanceolate and apically acute or acuminate with rigid spine-like tips. *Stachys fendleri* (Venezuela) differs from *S. riparia* in its longer calyces (3.5–5.75 mm), which are 3/4 the length to 1/3 longer than the corolla tubes and have teeth with rigid, spine-like tips.

Paratypes. COSTA RICA. **Limón:** Cordillera de Talamanca, Cantón de Talamanca, P.N. Cordillera de Talamanca, frente unión Quebrada Kirigú con Río Coen, entre Ujarrás y San José Cabecar, 28 Mar. 1993, *G. Herrera 6067* (INB not seen, MO); Cordillera de Talamanca, Cantón de Talamanca, P.N. Cordillera de Talamanca, fila arriba unión de Ríos Lori y Coen, entre Ujarrás y San José Cabecar, 29 Mar. 1993, *A. Fernández & W. Gamboa 919* (INB not seen, MO).

4. Stachys uniflora A. Pool, sp. nov. TYPE: Costa Rica. Puntarenas: Cantón de Coto Brus, Las Mellizas, cerro La Neblina, cabecera de Río

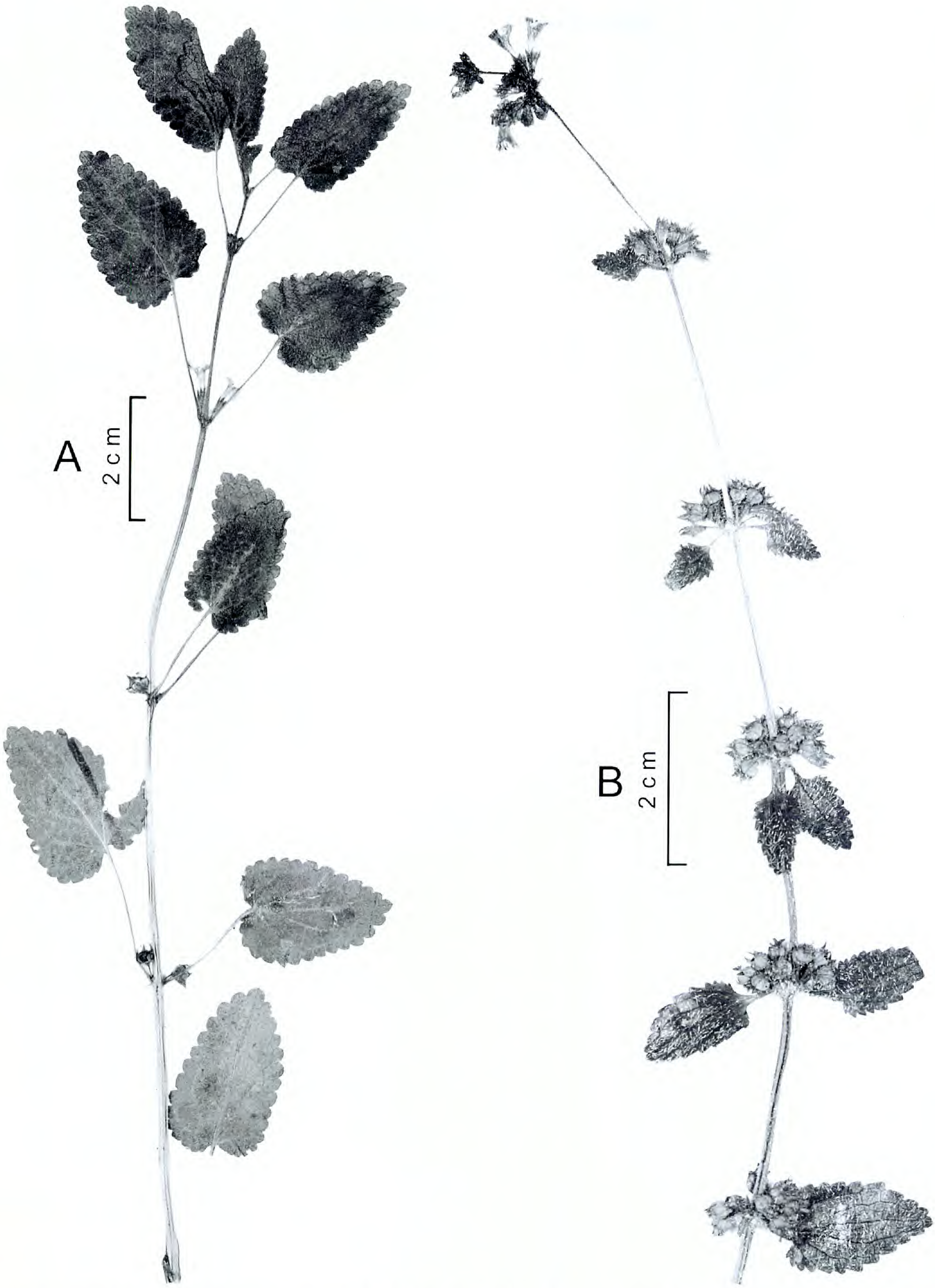

Figure 3. —A. *Stachys uniflora* A. Pool, habit (*A. Chacón 336* (MO), holotype). —B. *Stachys riparia* A. Pool, habit (*G. Herrera 6067* (MO), paratype).

Negro, alrededor de la laguna, 8°55′30″N, 82°45′40″W, 1600 m, 16 Aug. 1989, *A. Chacón 336* (holotype, MO; isotypes, CR not seen, INB not seen). Figure 3A.

Species nova *Stachydi pittieri* Briquet similis, sed ab ea floribus solitariis ad foliorum axillas, calyce longitudine corollae tubi 1/2–4/5 partes aequanti atque calycis dentibus in acumen debile desinenti differt.

Perennial herbs, 0.3–0.5 m, climbing, rooting only at lower nodes, pubescent, the indumentum a mixture of glandular-capitate hairs, 0.05–0.1 mm, spreading and eglandular hairs, coarse, 0.25–1 × 0.05 mm, tangled or spreading to retrorse, and fine, 0.05–0.1 mm, tangled or spreading to retrorse. Vegetative leaves 1–3.5 × 0.8–2.3 cm, ovate, adaxial surface with hairs 0.25–1 mm, abundant, abaxial surface with hairs 0.1–1 mm, abundant, the base cordate and shortly cuneate, the margins crenate, the apex acute or blunt acute; petioles 1–3.5 cm. Opposite cymes each reduced to 1 flower, the pairs of flowers widely spaced, all subtended by petiolate floral leaves not differing from vegetative leaves; pedicels 1.5–2 mm; bracteoles 0.75–1 mm. Flowering calyces 2.25–4.6 mm, 1/2 to 4/5 length of corolla tube, pubescent with hairs 0.5–0.75 mm, the tube 1.25–3.25 × 1–1.75 mm, narrowly obconic, the teeth 0.75–1.9 mm, 1/3 to 1/2 length of calyx, lanceolate, membranaceous, erect, apices acuminate with weak acumen; corollas pale pink, lilac-pink, or with tube white and lips pink, the tube 5–7 × 1.25–1.75 mm, 3/5 to 7/10 exserted from calyx tube, 1/5 to 1/2 exserted from total calyx, with annulus 1–2.5 mm above base, not saccate, the lower lip 3.25–4.25 mm, 1/2 to 3/4 length of corolla tube, middle lobe 2–3 mm, lateral lobes 0.75–1.25 mm, the upper lip 1.25–2.25 × 1.5–2 mm, 1/3 to 1/2 length of lower lip and forming 45°–90° angle with lower lip, rounded to slightly bifid; stamens exserted from corolla tube 0.5–1.25 mm; style exserted from tube 0.05–1.25 mm. Nutlets 2 × 1.76 mm, black.

Distribution. *Stachys uniflora* is endemic to southern Costa Rica and northern Panama, where it is found in disturbed areas, between 1600 and 2750 m elevation.

Conservation status. At this time the conservation status of *Stachys uniflora* is estimated to be Endangered (EN B1 a) (IUCN, 2001), as the extent of occurrence is estimated to be less than 5000 km^2 and there are less than five known localities. A search for this species might result in its status being lowered.

The flowers of *Stachys uniflora* are similar to those of *S. riparia*, *S. pittieri*, and *S. fendleri* in having a small upper corolla lip and the stamens only slightly exserted. *Stachys riparia* differs from *S. uniflora* in its 6- to 12-flowered verticillasters, which are subtended by reduced floral leaves, and relatively shorter, deltoid and apically obtuse calyx teeth. *Stachys pittieri* differs from *S. uniflora* in its 4- or 6-flowered verticillasters, which are subtended by reduced floral leaves, and flowers with the corolla tube included in to less than 1/5 exserted from the calyx and the calyx teeth with rigid, spine-like tips. *Stachys fendleri* differs from *S. uniflora* in its 6- or 8-flowered verticillasters, which are subtended by reduced floral leaves, and calyces that are 3/4 the length to 1/3 longer than the corolla tubes and have teeth with rigid, spine-like tips.

Stachys rotundifolia (Mexico to Chiapas) is the only other Central American species of *Stachys* with the flowers solitary in the axils of floral leaves similar in size to the vegetative leaves. It differs from *S. uniflora* in its broadly ovate to nearly circular leaves, larger flowers (calyx 5.75–8 mm, corolla tube 8–16 mm, upper corolla lip 3.25–7 mm), and rigid, spine-like calyx tooth tips.

Paratypes. COSTA RICA. **Limón:** Cordillera de Talamanca, headwaters of W branch of Río Teribe, betw. Río Sini & cont. divide at Cerro Bekom, 21 & 27 Mar. 1984, *G. Davidse, G. Herrera Ch. & R. H. Warner 26154* (MO). PANAMA. **Chiriquí:** pasture & "overgrown" area, Alto Respinga, 27 Sep. 1978, *W. G. D'Arcy 12152* (MO).

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Bulbostylis medusae (Cyperaceae), a New Species from Venezuela

Ana Paula Prata

Universidade Federal de Sergipe, Departamento de Biologia, Campus Universitário Professor Aloísio de Campos, 49100-000, São Cristóvão, Sergipe, Brazil. apprata@yahoo.com.br

Konraed Camelbeke

Arboretum Wespelaar vzw, De Costerstraat 37, B-3150 Haacht-Wespelaar, Belgium. arboretum.wespelaar@skynet.be

*Marc Reynders**

Ghent University, Department of Biology, Research Group Spermatophytes, K. L. Ledeganckstraat 35, B-9000 Gent, Belgium. Marc.Reynders@UGent.be. *Corresponding author.

Irene Carolina Fedón

Fundación Instituto Botánico de Venezuela, Curadora de Monocotiledóneas del Herbario Nacional de Venezuela (VEN), Apartado 2156, Caracas 1010-A, Venezuela. ircafe@cantv.net

Paul Goetghebeur

Ghent University, Department of Biology, Research Group Spermatophytes, K. L. Ledeganckstraat 35, B-9000 Gent, Belgium. Paul.Goetghebeur@UGent.be

Otto Huber

CoroLab Humboldt, Centro Internacional de Ecología Tropical/Instituto Venezolano de Investigaciones Científicas (CIET/IVIC), Apartado 21 827, Caracas 1020-A, Venezuela. ohuber@mac.com

Abstract. *Bulbostylis medusae* Prata, Reynders & Goetghebeur from Venezuela is fully described and illustrated. This species differs from all other South American *Bulbostylis* Kunth species by the combination of long-ciliated leaf sheaths, leaf apices, bracts, and spikelet axes. The new species resembles *B. sellowiana* (Kunth) Palla, and a comparison of the two species is made.

Key words: Cyperaceae, *Bulbostylis*, Venezuela.

During a study of Cyperaceae specimens from Venezuela, our attention was caught by a beautiful specimen of *Bulbostylis* Kunth. It was collected by A. Gröger during the preparation of a Florula de Las Lajas–Venezuela within the framework of the research project "Vegetation and ecogeographical differentiation of tropical Inselbergs" (Barthlott et al., 1993). Efforts to identify this specimen using treatments of Cyperaceae for Venezuela, e.g., Schnee (1943), and published keys for *Bulbostylis* in the surrounding regions were unsatisfactory. Since then it has remained unpublished and was designated by Kral (1998: 511) as "*Bulbostylis sp. A*" in the treatment of Cyperaceae for the *Flora of the Venezuelan Guayana*.

Bulbostylis is a Pantropical genus that comprises about 200 species. The highest concentration of *Bulbostylis* spp. can be found in Africa and South America. Diagnostic characters are the setaceous leaves, the pilose orifice of the leaf sheath, and the generally bulbous style base. Most species also have a fruit wall with vertically elongated cells.

Bulbostylis medusae Prata, Reynders & Goetghebeur, sp. nov. TYPE: Venezuela. Amazonas: mpio. Atures, carr. Pto. Ayacucho hacia El Burro, Km 28, 6 km en la desviación hacia el Este, Raudal del Agua Linda, 5°48′N, 67°26′W, rooted in clefts on granite soil, 14 May 1993, *A. Gröger 913* (holotype, VEN; isotypes, GENT, TFAV). Figures 1, 2.

Herba perennis, 30–60 cm alta; basis circumcincta vaginis foliorum pallide castaneis, numerosis pilis albis mixtis; radices crassae; culmi caespitosi, teretes. Folia 1/3–

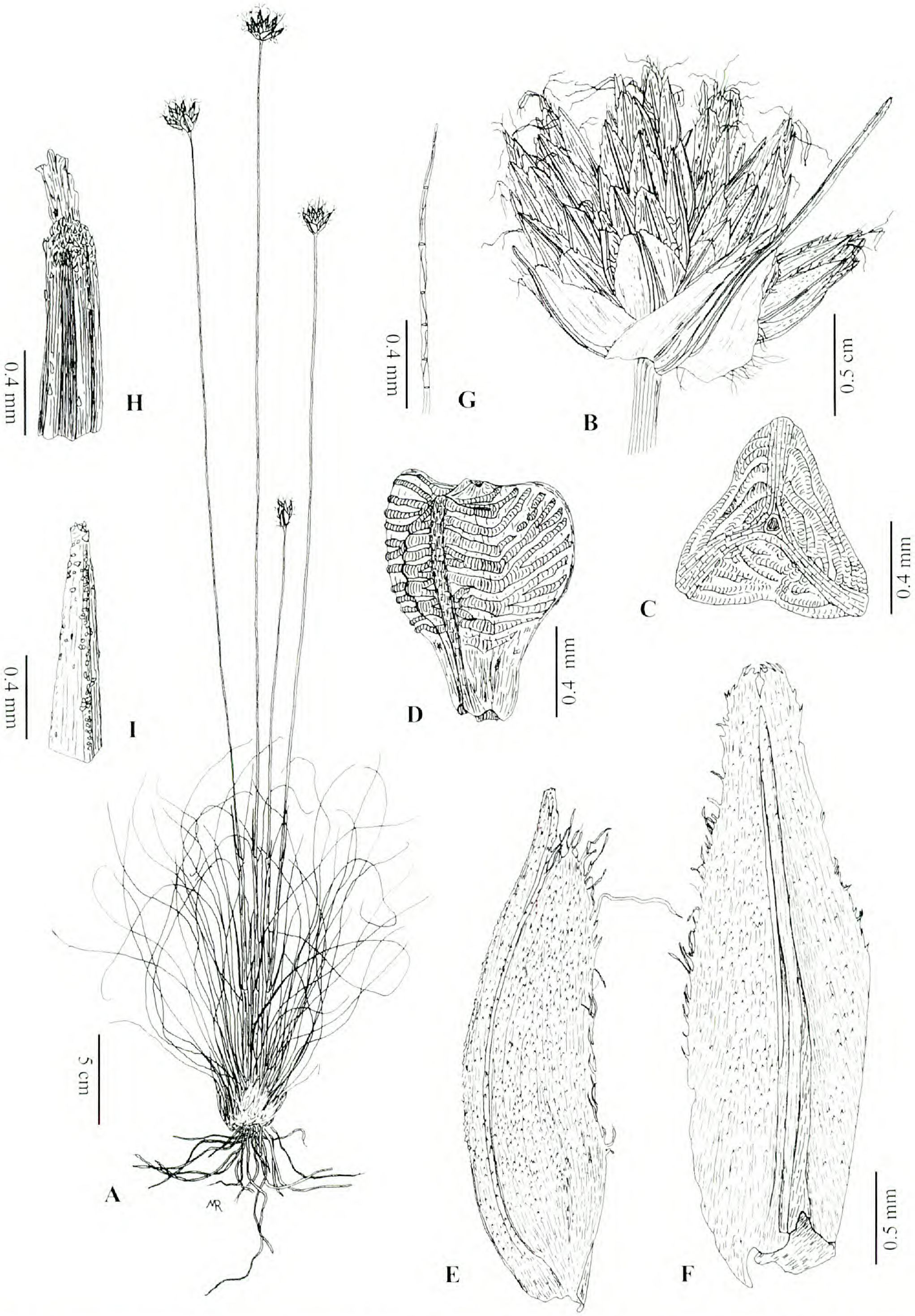
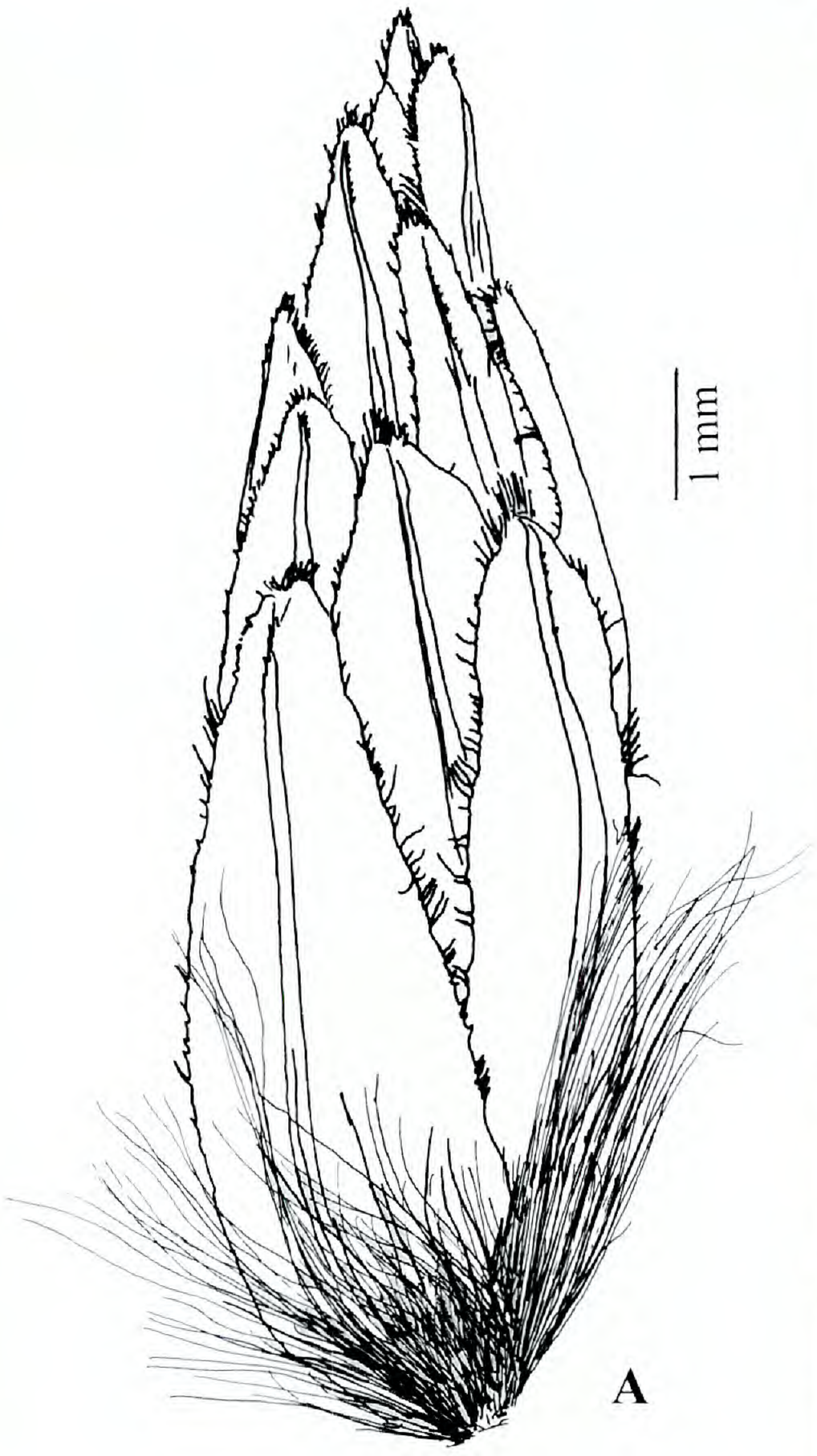
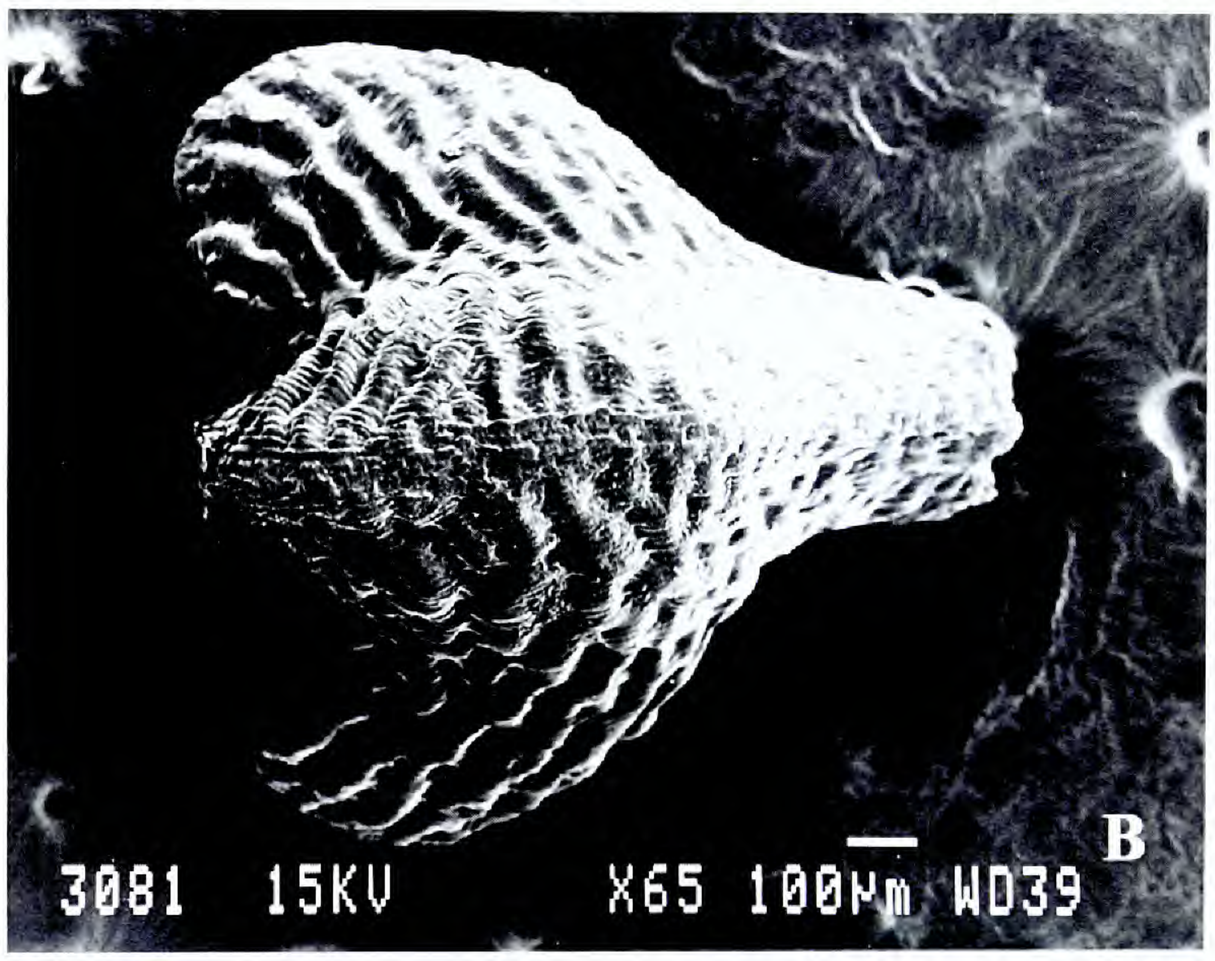


Figure 1. *Bulbostylis medusae* Prata, Reynders & Goetghebeur. —A. Habit. —B. Inflorescence. —C. Fruit, from above. —D. Fruit. —E. Lower glume. —F. Upper glume. —G. Hair from base of glumes. —H. Leaf tip with bunch of hairs. —I. Leaf tip of *B. sellowiana* (Kunth) Palla. Drawn by Marc Reynders: A–H from the holotype *Gröger 913* (GENT); I from *Furlan, Guilietti, Harley, Wanderley & Varanda 4569* (GENT).

1/2 culmi aequilonga, vaginae longitudinale costatae, papyraceae, apice obliquo, laminae setaceae, recurvatae, 11–22 × 0.03 cm, pagina superiore concava, pagina inferiore convexa, scabra praecipue secus margines atque nervum centralem. Inflorescentia capitata; spiculae 3 ad 7, ovatae, 11 ad 15 florae; bracteae involucrales 3 ad 7, glumiformes; glumae 3–4 × 1.3–1.5 mm, ciliatae. Achenium cordiforme, 0.7–1.5 mm longum, valde trilobatum,





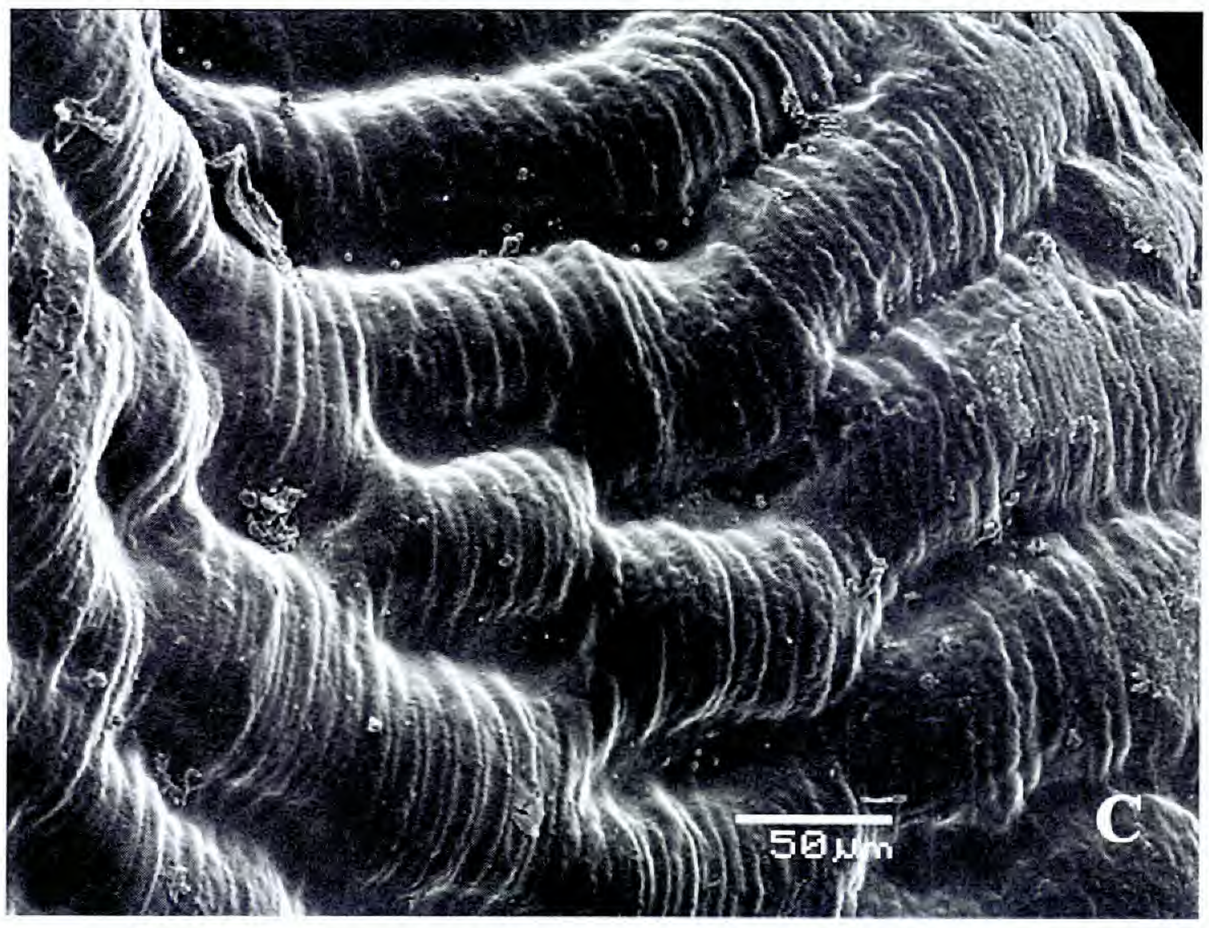


Figure 2. *Bulbostylis medusae* Prata, Reynders & Goetghebeur. —A. Spikelet with long-septate hairs between the glumes. —B. SEM micrograph of fruit. —C. SEM micrograph detail of fruit wall. A–C from the holotype *Gröger 913* (GENT); A drawn by K. Camelbeke.

faciebus valde transversim undulato-rugosis, bulbo stylino atrocastaneo, deciduo.

Perennial, caespitose herb, 30–60 cm tall, the base pale brown, obscured by the white pubescence of the lower leaf sheaths, roots thick (Fig. 1A); culm 0.6–1.2 mm thick, terete, longitudinally ribbed, grayish green to yellowish brown toward the base, densely puberulent or scabrid immediately below inflorescence, sometimes also in upper 20 cm, otherwise glabrous. Leaves 11–22 × 0.03 cm, 1/3–1/2 length of culm; leaf blades setaceous, recurved, curling and involute in dried state, scabrous mainly along the margins and central nerve, the apex rounded with a fascicle of short stiff hairs (Fig. 1H), adaxial face concave, smooth, abaxial face convex, canaliculate; sheaths 1–1.5 cm, papyraceous, apex oblique, abaxial face longitudinally ribbed, densely lanose with tufts of white hairs 0.5–1 cm, upper leaves with membranaceous sheaths surrounding the stem, with many long white hairs at their apex. Inflorescence 1–1.5 × 1.3–2 cm, capitate with 3 to 7 sessile spikelets (Fig. 1B); involucral bracts 3 to 7, suberect, glume-like, widened at the base, surface puberulent, papillose, the lowermost bract 1–1.7 cm, slightly overtopping the inflorescence, the others gradually smaller, margin lacerate, fimbriate, with white hairs 0.3–0.5 cm; spikelets 10–15 × 3–4 mm, narrowly ovoid, acute, 11 to 15 flowers, rachilla internodes with tufts of white septate hairs, 0.5 cm (Figs. 1G, 2A); glumes persistent, 3–4 × 1.3–1.5 mm, lanceolate, light brown, papyraceous, midrib 3-nerved, not excurrent, surface ciliolate, papillose, acute, margin lacerate, ciliate (Fig. 1E, F). Flowers bisexual; stamens 3, anthers 0.5–0.8 mm, linear; style trifid, 2 mm, branches 0.6 mm, style base early deciduous, narrowly thickened, ca. 0.5 mm long. Achene 0.7–1.5 × 0.6–1 mm, trigonous cordiform, broadly 3-lobed (Figs. 1C, 2B), narrowed at base (Fig. 1D), ribs thickened, surface transversely rugose and finely longitudinally striate (Fig. 2C), silica bodies present mainly along the ribs,

Table 1. Morphological differences between *Bulbostylis medusae* and *B. sellowiana*. The character description of *B. medusae* is based on *A. Gröger 913* (GENT) and that of *B. sellowiana* on *Furlan, Guilietti, Harley, Wanderley & Varanda 4569* (GENT) and *Wettstein & Schiffner s.n.* (WU).

	B. medusae	*B. sellowiana*
Plant base	with white hairs	with orange to reddish hairs
Leaf		
blade	recurved	strictly erect
apex	rounded with a fascicle of short, stiff, white hairs (Fig. 1H)	conspicuously narrowed, always glabrous (Fig. 1I)
Achene		
shape	cordiform	suborbicular-obovoid
apex	strongly trigonous	slightly trigonous
base	conspicuously attenuate	slightly attenuate

brown to dark brown at maturity; pyramidal, ca. 1/4 length of achene.

Distribution and habitat. The species described here grows in savannas of *Trachypogon* Nees in oligotrophic sandy soil with dispersed ferrous conglomerates, on granitic outcrops next to *Utricularia* L. The climate in the area is biseasonal with a dry season from December to February and rainy season from March to November, and with maximum rainfall in July. The average precipitation is 2345.97 mm per year, and the average temperature is 26.53°C. The Amazonas state is located in the Guyana–Brazilian Shield region, which is composed mostly of metamorphic and granitic igneous rock considered to be from the Precambrian period (MARNR, 1983; Blanchaneaux & Pouyllau, 1977).

Numerous papers have been written about the generic delimitation of *Abildgaardia* Vahl, *Bulbostylis*, and *Fimbristylis* Vahl (e.g., Lye, 1971; Goetghebeur & Coudijzer, 1985). Herein we recognize these three genera as separate; the new species described can be identified as *Bulbostylis*. Important diagnostic characters for the genus were provided at the beginning of this paper.

The new species can be included in Section III of Clarke (1908) based on the presence of a 3-fid style and an inflorescence consisting of one head. In the classification of Osten (1931), the species should be included in the section *Umbellatae*.

Bulbostylis medusae is most similar to *B. sellowiana* (Kunth) Palla (Kunth, 1837: 208; Nees, 1842: 27, 89; Böckeler, 1870: 748; Lindman, 1900: 17; Palla, 1908: 179) by its habit and the structure of the inflorescence. *Bulbostylis medusae* differs, however, by the white hairs surrounding the base of the plant, the recurved leaf blades, the rounded apex of the leaves with a fascicle of short stiff hairs, and the cordiform fruit with trilobed apex. A comparison of *B. medusae* and *B. sellowiana* is made in Table 1. The stem base of *B. medusae* is densely covered by tufts of long white hairs from the abaxial face of the leaf sheaths. The spikelets have similar tufts of long, white, multicellular hairs, evident on the abaxial face of the lower glumes and on the rachilla. These combinations of characters have not been noted in any other species of *Bulbostylis*. *Bulbostylis medusae* also differs from other *Bulbostylis* species by its leaf tip with a fascicle of hairs. The leaf tips of *B. medusae* and *B. sellowiana* are compared in Figure 1H and 1I.

Two other South American species also resemble *Bulbostylis medusae*. These are *B. emmerichiae* T. Koyama (distribution: Brazil: Bahia, Mato Grosso, Goiás, and Minas Gerais) (1974: 429) and *B. lombardii* Kral & M. T. Strong (distribution: Brazil: Minas Gerais) (1999: 850). Both of these species can be distinguished from the new species by the presence of a short, suberect caudex. *Bulbostylis lombardii* also has a persistent style base, while the two others have a deciduous one.

Identification of the new species with a key for North America (Kral, 1971) resulted in *Bulbostylis warei* (Torrey) C. B. Clarke, a species with fimbriate-pectinate involucral bracts and prominently lobed achenes. *Bulbostylis warei*, however, differs from *B. medusae* in its shorter spikelets (4–5 mm), smooth or minutely puberulent scales, habitat, and its North American distribution.

Taxonomic knowledge of American *Bulbostylis* species with capitate or anthelate inflorescences is poor, and a revision is sorely needed. For the unispiculate species, an enumeration (including a key to the species) has already been published (Goetghebeur & Gröger, 1993).

Etymology. The specific epithet "*medusae*" refers to the reminiscence of the recurved leaf blades to the hair of Medusa in Greek mythology.

Paratypes. VENEZUELA. Amazonas: mpio. Atures, Puerto Ayacucho, betw. electric power plant & Orinoco River, 14 June 1984, *G. Davidse & J. S. Miller 25440* (NY); Pisicultura Station, ca. 8 km S of Puerto Ayacucho, 22 June

1984, *G. Davidse & J. S. Miller 26340* (TFAV); al sur de Puerto Ayacucho, cerca de Mirabal, lado este de la carretera hacia Samariapo, 100 m, 24 Aug. 2006, *S. Nozawa 1147* (TFAV, VEN).

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Two New Species in the *Tillandsia utriculata* Complex (Bromeliaceae) from Mexico

Iván M. Ramírez M. and Germán Carnevali F. C.

Herbarium CICY, Centro de Investigación Científica de Yucatán, A.C., Calle 43 #130, Colonia Chuburná de Hidalgo, Mérida 97200, Yucatán, México. ramirez@cicy.mx; carneval@cicy.mx

Abstract. Two new species in the *Tillandsia utriculata* (L.) L. complex (Bromeliaceae) from Mexico are proposed. Both are herein described and illustrated with their affinities discussed. The first new entity, *T. aesii* I. Ramírez & Carnevali from the states of Jalisco, Guerrero, and Oaxaca, is similar to *T. makoyana* Baker, but the new taxon has an open rosette with leaves that are green adaxially and white lepidote abaxially (vs. a funnelform rosette with gray leaves on both surfaces in *T. makoyana*), actinomorphic flowers with a light apple-green corolla (vs. zygomorphic with a purple to light purple corolla). The second taxon proposed here, *T. pinicola* I. Ramírez & Carnevali, from the state of Oaxaca, is also similar to *T. makoyana*, but is a smaller plant with a more compact growth habit and leaves with proportionally shorter leaf blades that abruptly attenuate from a broad sheath (vs. gradually attenuate into the proportionally longer blade) into a sub-acicular apex. It is also characterized by typically growing on pines, hence the epithet.

Resumen. Dos nuevas especies en el complejo *Tillandsia utriculata* (L.) L. (Bromeliaceae) de México se proponen como nuevas. Ambas se describen, se discuten sus afinidades y se documentan con ilustraciones y fotografías. La primera especie *T. aesii* I. Ramírez & Carnevali de los estados de Jalisco, Guerrerro y Oaxaca, es similar a *T. makoyana* Baker pero la nueva especie tiene rosetas abiertas con hojas verdes adaxialmente y blanco lepidotas abaxialmente (vs. rosetas en forma de embudo con hojas grises en ambas superficies en *T. makoyana*), flores actinomórficas con corola verde manzana claro (vs. flores zigomorfas y con pétalos púrpura o púrpura claro). La segunda especie, *T. pinicola* I. Ramírez & Carnevali, del estado de Oaxaca, es también similar a *T. makoyana* pero es una planta más pequeña con un hábito de crecimiento más compacto y hojas proporcionalmente con láminas foliares más cortas las cuales se atenúan abruptamente en una vaina ancha (vs. vainas atenuándose gradualmente en láminas foliares proporcionalmente más largas) con un ápice acicular. Esta nueva especie también se caracteriza por crecer en pinos, de allí su epíteto.

Key words: Bromeliaceae, Mexico, *Tillandsia*.

The genus *Tillandsia* L. was classified in seven subgenera by Mez (1896) and later supported by Smith and Downs (1977) in their *Flora Neotropica* treatment of the entire Bromeliaceae. The high levels of homoplasy in several morphological characters (such as petal appendages) considered important in traditional classifications (including that of Smith and Downs) have blurred our understanding of the limits of the supraspecific groups within the genus. Some of the subgenera recognized by Mez (1896) and Smith and Downs (1977) have been recently treated as distinct genera, i.e., *Racinaea* M. A. Spencer & L. B. Smith, formerly *Tillandsia* subg. *Pseudocatopsis* Baker (Spencer & Smith, 1993), but without the necessary phylogenetic work to back up the proposals despite their wide acceptance by several taxonomists (e.g., Luther, 1995; Morales, 2003).

Recent novel research and the analysis of new characters (ranging from the re-evaluation of fresh floral material to newly generated DNA nucleotide sequence data) have allowed a better understanding of the relationships within the genus (Gardner, 1986; Terry et al., 1997; Barfuss et al., 2005), but more studies are required before more taxonomic and nomenclatural changes are warranted within the Tillandsioideae. Furthermore, in the most recent phylogenetic study based on DNA sequence data from seven plastid regions, none of the subgenera of *Tillandsia* were found to be monophyletic (Barfuss et al., 2005).

Studies at the population and at the species-complex levels using field data (e.g., habitat and distribution analysis, ecology) and the careful analysis of fresh material either in the field or under cultivation can provide a wealth of new data that are usually unavailable when only working with herbarium material (see Gardner, 1986, for a good example). Within *Tillandsia*, some species complexes, including the relatives of *T. utriculata* (L.) L., can only be understood with this kind of approach because most of the relevant features required to diagnose the taxa in the group become lost upon vouchering, including

plant architecture. In many cases, the taxa that compose these species complexes are allopatric or parapatric, but because herbarium data are scarce, they fail to reveal the often subtle ecological and geographical patterns, which can only be disclosed with extensive fieldwork and an abundant herbarium record.

A brief description of the *Tillandsia utriculata* complex was provided by Ramírez et al. (2004). Described species in the *T. utriculata* complex include *T. makoyana* Baker, *T. limbata* Schlechtendal, *T. dasyliriifolia* Baker, *T. pringlei* S. Watson (treated by Gardner (1984) as *Tillandsia utriculata* subsp. *pringlei* (S. Watson) C. S. Gardner), *T. utriculata*, *T. calcicola* L. B. Smith & Proctor, *T. cucaensis* Wittman, *T. pulvinata* Baker, *T. geniculata* Baker, and a few other related species, some of which are probably still undescribed. A few additional taxa, such as *T. flexuosa* Swartz, *T. karwinskyana* Schultes f., and *T. albida* Mez & Purpus have inflorescences and flowers that recall those of this complex, but the plants are strikingly different. Phylogenetic analyses are required to better ascertain the position of these taxa. *Tillandsia utriculata* is the type species of the genus.

As a result of extensive fieldwork in Mexico, as well as cultivation of plants of the group for several years, the delimitation of taxa in the *Tillandsia utriculata* complex in Mexican populations is now better understood. Species whose identities and circumscriptions have come into focus with the study of this complex include *T. dasyliriifolia* (Ramírez et al., 2004), *T. limbata* Schlechtendal (Espejo et al., 2005), and *T. makoyana*. The type of the latter species is a watercolor painting by Edouard Morren housed in the Kew library without collection data; the name has been applied in herbaria and in the literature (e.g., Smith & Downs, 1977) to several species of the *T. utriculata* complex that display purple corollas. Our interpretation of Morren's plate is that it is conspecific with a species that commonly features a rosette of straight, erect (not twisted nor spreading) gray leaves and purple or light purple corollas that are slightly zygomorphic. *Tillandsia makoyana* has been collected at varying elevations ranging from sea level to ca. 2000 m in central Mexico and is variable in plant size and inflorescence length. However, in most individuals of the species the peduncle of the inflorescence is about as long to slightly longer than the leaves.

As a result of this newly gained understanding of relevant species in the *Tillandsia utriculata* complex, particularly the identity of *T. makoyana*, during the course of this study two distinctive new entities became apparent. The new taxa herein described had been previously collected, but had until now remained misidentified in herbaria variously as *T. limbata*, *T. makoyana*, and/or *T. dasyliriifolia*.

Tillandsia aesii I. Ramírez & Carnevali, sp. nov. TYPE: Mexico. Jalisco: mpio. La Huerta, alrededores de la Est. Biol. Chamela, ca. 19°30′N, 105°03′W, 0–10 m, 12 Mar. 2002, *G. Carnevali & I. M. Ramírez 6973* (holotype, CICY [3]). Figure 1.

Haec species *Tillandsiae makoyanae* affinis est sed rosula aperta, superficie adaxiali foliorum viride non cinerea; inflorescentia breviore, spicis paucioribus ceraciter vestitis; floribus actinomorphis cylindricis cum sepalis petalisque et stigma viridibus differt.

Epiphytic *herb*, 62–100 cm high, with 1 to 4 basal rosettes on the flowering or fruiting plant, or the plants (more commonly) monocarpic; *rosette* with 12 to 18 leaves when flowering, with open aspect, slightly funnelform when young, foliar blades slightly to strongly twisted (curved outward and pointing forward), spreading to reflexed, foliar sheaths barely impounding. *Foliar sheaths* of external leaves almost flat, those of internal leaves forming a funnelform structure, straight and erect, white-lepidote externally, somewhat concave; *foliar blades* widely triangular at base, attenuate and acute, long-caudate, coriaceous, rather stiff, conspicuously nerved abaxially, 30–32 × 2.5–4 cm, light green adaxially, white-lepidote abaxially, margins slightly curving upward into a canaliculate structure. *Inflorescence* pyramidal, a panicle, 32–39 cm, with up to 11 spikes, the new inflorescence developing very slowly and taking up to 3 months before the first flowers open; successively flowering basipetally for several weeks; *peduncle* shorter or as long as the leaves, pink, glaucous, 21–40 cm, ca. 1 cm diam., covered by tubular, acute, imbricate bracts; *internodes* 2–4 cm long; *bracts* of the peduncle almost covering the internodes, green and glaucous, 3.5–4.5 × 2–2.6 cm (longer and wider toward the base), widely triangular, acute, margins hyaline, conspicuously nerved when dry, slightly surpassing the internodes; *inflorescence rachis* red or pinkish flesh-colored, 0.5 cm diam., naked, flexuous, erect; *spikes* 8 to 11, *rachis* green, almost obscured by floral bracts, dorsoventrally flattened with flowers in 2 rows; *bracts of the spikes* widely triangular, obtuse, 2.3 × 1.4 cm, entire, slightly pink, white-lepidote; *floral bracts* narrowly triangular, nerved, acute, margins hyaline, barely covering the rachis, 1.4 × 0.8–0.9 cm, green, shorter than the sepals, white lepidote adaxially. *Flowers* 5–6.5 cm, actinomorphic, erect, 1 to 4 open daily per inflorescence (1 at a time per spike), each flower lasting 1 day, protandrous, odorless, basally geniculate; *sepals* narrowly triangular to wide-elliptic,

Figure 1. *Tillandsia aesii* I. Ramírez & Carnevali. —A. Habit. Scale bar = 10 cm. —B. Upper row, from left to right: flower, flower with floral bract removed, flower without floral bract, sepals, and petals showing the ovary, style, stigma, filaments, and anthers. Bottom row from left to right: floral bract, three sepals, and three petals. Scale bar = 4 cm. Based on the holotype *G. Carnevali & I. M. Ramírez 6973* (CICY). Margins of sepals and floral bracts are somewhat revolute in the figures.

obtusely acute, 1.8–2.5 × 0.7–1.3 cm, 2 sepals basally connate by 6–15 mm, apple green, slightly darker and shinier than petals; *petals* narrowly oblong, apically rounded, 3.2–3.8 × 0.4–0.8 cm, slightly oblique, constricted ca. 1.5 cm distally from base, pale green to cream-green, basally white; *stamens* exserted, in 2 series, filaments concolorous with petals, plicate, lighter at the base, 5–5.5 cm; *anthers* brown, 8 mm, dorsifixed, pollen yellow; *ovary* 15 mm, pyramidal; nectar sweet, abundant, 31° Brix (total concentration of sugars); *stigma* exserted, slightly protruding above the anthers at anthesis, lobes conduplicate, somewhat spiraled, 4.7–4.9 cm, basally light green, apically apple green. *Fruits* and *seeds* not observed.

Habitat, distribution, and phenology. *Tillandsia aesii* is found in low, dry, caducifolious forests, associated with *Cnidoscolus* Pohl, *Plumeria* L., *Pseudosmodingium* Engler, *Agave* L., *Opuntia* (L.) Miller, *Pedilanthus* Necker ex Poiteau, *Cordia elaeagnoides* DC., *Bursera simaruba* Sargent, xeromorphic epiphytes such as *Tillandsia ionantha* Planchon, *T. intermedia* Mez, *T. caput-medusae* E. Morren, *T. concolor* L. B. Smith, *Encyclia adenocarpon* (La Llave & Lexarza) Schlechter, *Myrmecophila galeottiana* (Reichenbach f.) Rolfe, Cactaceae such as *Pachycereus* (A. Berger) Britton & Rose, and thorny leguminous trees and shrubs. It has been collected at 0–600 m of elevation, on the Pacific coast of Mexico. Flowering specimens were collected from March through July, and fruiting specimens were collected from May through September.

Eponymy. The name is based on an acronym of the initials of Dr. Adolfo Espejo Serna, a Mexican botanist associated with herbarium UAMIZ of the Universidad Autónoma Metropolitana in Mexico, D.F., whose work in Bromeliaceae and other monocots has contributed greatly to the knowledge of the Mexican flora.

Tillandsia aesii is phenetically similar and probably phylogenetically closest to *T. makoyana*, a species that commonly features a rosette of straight, erect (not twisted and spreading) leaves. *Tillandsia makoyana*, furthermore, displays purple or light purple flowers and a slightly zygomorphic corolla as opposed to the actinomorphic, green, tubular corolla of *T. aesii*. Both species have been collected at varying elevations ranging from sea level to ca. 2000 m, but *T. aesii* has only been collected at elevations from sea level to ca. 600 m and in dryer environments.

At least three other vegetatively similar taxa in the *Tillandsia utriculata* complex display pale flowers. The widespread *T. utriculata* features longer, thinner (easy to bend) peduncles and branches and the smaller, white corollas are gibbous or somewhat inflated with the petals convergent at apex. *Tillandsia dasyliriifolia* and *T. limbata* are easily distinguished from *T. aesii* by their inflorescences with much longer peduncles bearing flowers with white, slightly zygomorphic corollas. *Tillandsia aesii* is further distinguished from these two taxa by the proportionally smaller rosette of stiff leaves that are slightly twisted. In addition, *T. dasyliriifolia* and *T. limbata* are restricted to the humid lowlands of the Gulf Coast of Mexico (*T. limbata*) or to the Yucatan Peninsula (*T. dasyliriifolia*).

Paratypes. MEXICO. **Guerrero:** mpio. Huitzuco, Amatitlán, 12 km SE del Huitzuco, 4 June 1985, *J. C. Soto Núñez & Aureoles C. 8786* (MEXU). **Jalisco:** mpio. La Huerta, alred. Est. Biol. Chamela, 3 Nov. 1997, *G. Carnevali & G. Salazar 4767* (CICY); camino por la base SE del Cerro de la Tambora, 16 Jan. 1985, *P. Magaña Rueda & E. Lott 10* (MEXU); Chamela Field Stat., 100 km S of Puerto Vallarta, 26 Sep. 1988, *A. Gentry 63981* (MO). **Oaxaca:** mpio. Matías Romero, carr. entre La Ventosa y el entronque a Juchitán, 10 km N de La Ventosa, 4 May 1997, *G. Carnevali, G. Campos, M. Gómez & F. May 4438* (CICY); mpio. Asunción Tlacolulita, dist. Yautepec, ca. 9 km después de Reforma sobre camino a Tehuantepec–Oaxaca, 2 Sep. 2002, *I. Ramírez, A. Espejo, A López, J. Ceja y A. Mendoza 998* (CICY); mpio. Asunción-Ixtaltepec, distrito Juchitán, 1 km después de Santiago de Ixtaltepec, 2 Sep. 2002, *I. Ramírez, A. Espejo, A López, J. Ceja y A. Mendoza 979* (CICY); 28 km NW of La Ventosa, along Trans-Isthmian hwy. (rte. 185), 17 July 1958, *R. M. King 630* (MICH, TEX, US); flat grazed area 5.5 km NE of Juchitán, along Pan-Amer. hwy. (rte. 190), 2 July 1958, *R. M. King 360* (MEXU, MICH, TEX, US); flat grazed area 4 km N-NE of Tehuantepec along the Trans-Isthmian hwy. (rte. 185 & 190), 5 July 1959, *R. M. King 1352* (LL); flat grazed area 16 km N-NE of Tehuantepec, 7 July 1959, *R. M. King 1389* (TEX); mtns. along rte. 190, ca. 74 miles SE of Oaxaca, 22 June 1960, *R. M. King 2975* (TEX, US); Tehuantepec, dry open savannah, 2 Apr. 1957, *M. B. Foster & O. C. Van Hyning 2939* (US [2]); on rte. 185, 6 km N of Union Hidalgo, 10 July 1958, *W. G. Williams Jr. & D. Francoeur 21* (MICH); on rte. 185, 15 km N of Union Hidalgo, at edge of steep drop into a small valley, 11 July 1958, *Walter G. Williams Jr. & Don Francoeur 24* (MICH); mpio. Nejapa de Madero, distrito Yautepec, 2.4 km al N-NE de Río Hondo, brecha a Asunción Lachixonase, 16 May 1995, *A. Salinas T. & E. Martínez-Correa 8155* (MEXU).

Tillandsia pinicola I. Ramírez & Carnevali, sp. nov. TYPE: Mexico. Yucatán: Mérida, floreciendo en cultivo, 13 Jan. 2005, *I. Ramírez & G. Carnevali 1274* (holotype, CICY [2]; isotype, MO) [Oaxaca: mpio. Santa María Chimalapa, Dist. Juchitán, ca. 20 km después de el Mezquite, 7 km después de Lázaro Cárdenas rumbo a Santa María Chimalapa, 16°46′10″N, 94°50′38″W, ca. 385 m, colectada originalmente por I. Ramírez, A. Espejo, A. López-Ferrari, A. Mendoza & J. Ceja el 2 Sep. 2002]. Figure 2.

Haec species *Tillandsiae makoyanae* affinis est sed planta ambito parviore, foliorum vaginis latissimis, foliorum laminis proportione brevioribus, apice acicularibus abrupte attenuatis (vs. paulo apicaliter attenuatis), et habitatio pinicola abhorret.

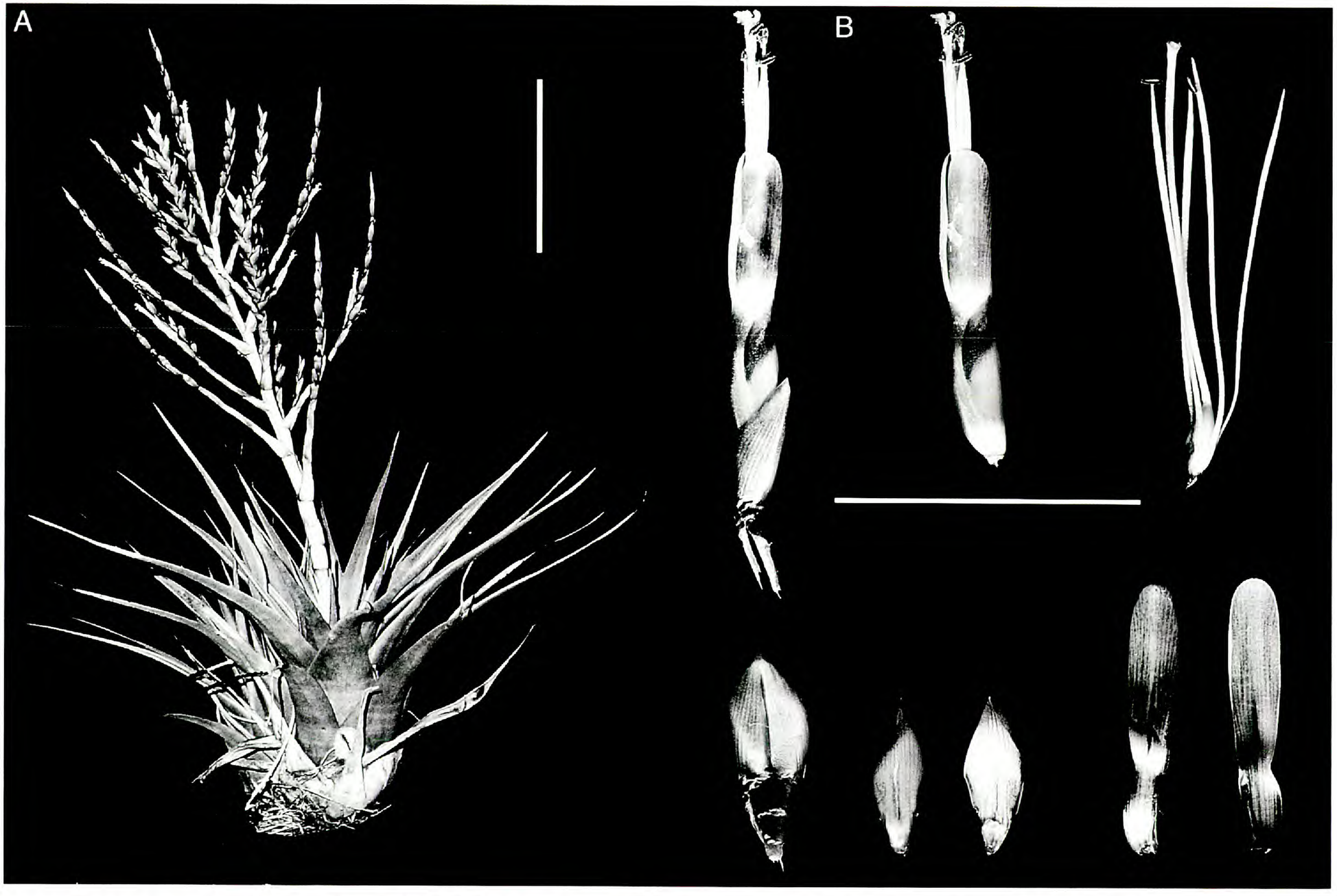

Figure 2. *Tillandsia pinicola* I. Ramírez & Carnevali. —A. Habit. Scale bar = 10 cm —B. Upper row, from left to right: flower, flower with floral bract removed, flower without floral bract, sepals, and petals showing the ovary, style, stigma, filaments, and anthers. Bottom row from left to right: floral bract, two sepals, and two petals. Scale bar = 3 cm. Based on the holotype *I. Ramírez & G. Carnevali 1274* (CICY). Margins of sepals and floral bracts are somewhat revolute in the figures.

Epiphytic *herb*, 50–60 cm high, the rosettes apparently monocarpic; *rosette* with 20 to 30 leaves when flowering, leaves erect with divergent apices, with funnelform rosette, apices erect when young or fruiting and then the rosette shape subcylindrical, foliar sheaths barely impounding. *Foliar sheaths* with incurved margins, 6–10 × 6–8 cm, elliptical, green, adaxially dark castaneous upon drying; *foliar blades* narrowly triangular abruptly attenuating into an acicular apex, margins incurved, coriaceous, rather stiff, conspicuously nerved abaxially, 15–18 cm long, 3.8–4.5 cm wide at the base, concolorous dull green, slightly white-lepidote abaxially. *Inflorescence* an erect panicle, 40–60 cm, ovoid-ellipsoid, some of the lowermost branches 2-pinnate, 50–60 cm long from the base of the rosette, with 11 to 16 spikes, the new inflorescence developing slowly and taking up to 2 months before the first flowers open; successively flowering basipetally and producing new flowers for 2 to 3 weeks; *peduncle* 10–15 cm, shorter or as long as the leaves, bright crimson red, glabrous, ca. 1 cm diam., covered by tubular, acute, imbricating bracts; *internodes* 2–3 cm long; *bracts* of the peduncle slightly shorter than the internodes and not totally enveloping them, crimson with green tinges, glabrous, 3.5–4.5 × 2–2.6 cm (longer and wider toward the base), widely triangular, acute, margins hyaline, conspicuously nerved when dry, slightly surpassing the internodes; *inflorescence rachis* crimson red, of smaller diameter than the peduncle, naked, flexuous, the branches diverging at angles of 45°–60° to the inflorescence rachis; *basal spikes* 15–17 cm, apical ones 9–12 cm, sterile portion of basal ones 6.5–7.5 cm, of the apical ones 1.8–2.5 cm, rachis green with dark red tinges, almost entirely covered by floral bracts, dorsoventrally flat with flowers in 2 rows; (5 to)10 flowers per branch; *bracts of the spikes* 1–1.8 cm (longer ones at base), widely triangular, obtuse, pale crimson with slight greenish tinges, glabrous, similar in shape to the floral bracts; *floral bracts* 1.6–1.8 × 9–10 mm, ovate-elliptic, acute, conspicuously nerved, margin hyaline, shorter than sepals, barely covering the rachis, those subtending mature flowers dull crimson, apple green toward dorsal portion, more immature flowers apple green with crimson confined to the margins and apex, glabrous, shiny. *Flowers* 3.3–3.5 cm, actinomorphic, forming an acute angle with the rachis, up to 7 flowers open daily per inflorescence (1 at a time per spike), each flower lasting 1 day, protandrous, odorless, basally very slightly geniculate; *sepals* spathulate-elliptic, broadly acute, 1.5 cm × 6 mm, the 2 adaxial ones basally connate for 4–6 mm, apple green, apically and marginally dull red-maroon, adaxially sparsely lepidote, more so toward apex; *petals* narrowly oblong, apically rounded, 2.8–3 × 0.5 cm, slightly oblique, constricted about 1.5 cm distally from base, dull purple, paler toward the base, the portion hidden by the sepals hyaline, exserted portion 1.8–2 cm long; *stamens* exserted, in 2 series of unequal length, filaments pale cream-green, plicate upon drying, lighter at the base, 3.7–3.8 cm, flatter toward the base; *anthers* brown or black-brown, 4.5 mm, 8–14 mm thick, dorsifixed, pollen yellow; *ovary* 8 × ca. 3 mm, ellipsoid-pyramidal; nectar sweet, abundant; *stigma* exserted, slightly protruding above the anthers at anthesis, lobes conduplicate, not spiraled; *style* 4.4 cm, basally light green, apically apple green. *Fruits* and *seeds* not observed.

Habitat, distribution, and phenology. *Tillandsia pinicola* grows on pine trees, mostly *Pinus oocarpa* Schiede ex Schlechtendal, and is associated with *Catopsis berteroniana* (Schultes & Schultes f.) Mez, *T. streptophylla* Scheidweiler ex E. Morren, and *T.* aff. *fasciculata* Swartz. It occurs at 300–400 m in elevation and is known only from Mexico (Oaxaca). It has been collected in flower during January and in fruit in September.

Tillandsia pinicola is one of the most distinctive members of the *T. utriculata* complex by its small size, erect, green leaves that are relatively short and with wide sheaths, and its inflorescence with short peduncles and purple flowers. It is very similar to *T. makoyana* and the new species herein described as *T. aesii*, but it differs from them by the overall smaller size, the foliar sheaths wide and abruptly attenuating into a narrow foliar blade that ends in an acicular apex, leaves strongly nerved when alive or dry, leaves dark green on both sides but lightly white-lepidote on the abaxial surface, the inflorescence with a short peduncle that is usually shorter than the leaves, much shorter flowers and floral bracts, and branches that are both fewer in number and shorter.

Paratypes. MEXICO. **Oaxaca:** mpio. Santa María Chimalapa, distrito Juchitán, ca. 20 km después de El Mezquite, 7 km después de Lázaro Cárdenas rumbo a Santa María Chimalapa, 2 Sep. 2002, *I. Ramírez, A. Espejo, A. López-Ferrari, A. Mendoza & J. Ceja 987* (CICY, UAMIZ); mpio. Lázaro Cárdenas, dist. Juchitán, 3.6 km al E de Lázaro Cárdenas, hacia Santa María Chimalapa, entrando por el Mezquite, 22 Jan. 1988, *R. Torres C. & E. Martínez 11225* (IEB, MEXU).

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A New Penicillate-Stigma Species of *Waltheria* (Sterculiaceae, Hermannieae) Endemic to Belize

Janice G. Saunders and Raúl Pozner

Instituto de Botánica Darwinion, C. C. 22, B1642HYD San Isidro, Pcia. Buenos Aires, Argentina. jsaunders@darwin.edu.ar; rpozner@darwin.edu.ar

Abstract. *Waltheria belizensis* J. G. Saunders, a new distinctive Sterculiaceae species known only from Mountain Pine Ridge National Forest Reserve, Cayo District, Belize, and potentially distylous by floral morphology, is described and illustrated. It is placed in section *Waltheria* L. in the *W. cinerescens* A. St.-Hilaire alliance by its penicillate stigma and loculicidal capsule with an extensive corneous endocarp. It is closest to the distylous *W. petiolata* K. Schumann in Martius from Brazil (Rio de Janeiro) by the decomposite inflorescences; the shape, venation, and vestiture of calyces; and the shapes of petal apices and seeds. *Waltheria belizensis* differs from *W. petiolata* by leaves with minute, appressed vestiture, revolute teeth margins, and a greater number of lateral veins; corymbiform inflorescences; and a seed less lobed and less pusticulate. The contrasting characters are detailed in a key. Thrum-like pollen of *W. belizensis* and thrum pollen of confirmed *W. petiolata* are reported for the first time. These data suggest the thrum-like pollen of the Belizean species is less derived than that of the Brazilian one. A key is provided to separate *W. belizensis* from the only other species of *Waltheria* in Belize, *W. indica* L. s.l. The present and additional studies concur with previous exclusion of *W. glomerata* C. Presl from the flora of Belize, based solely on *Dwyer & Liesner 12292*, the type of *W. belizensis*. Other Belizean plant endemics found in the Mountain Pine Ridge National Forest Reserve are listed, and the region is discussed.

Key words: Belize, Byttnerioideae, Hermannieae, Malvaceae, Mountain Pine Ridge Reserve endemics, pollen morphology, Sterculiaceae, *Waltheria*.

Revision of material of *Waltheria* L. (Sterculiaceae[1]) for *Flora Mesoamericana* and a generic monograph (Saunders, 1995) have revealed a very distinctive undescribed species known only from Belize, as well as the first *Waltheria* species endemic to Mesoamerica. It is presented in detail here because the new taxon is not included in the monograph and is possibly rare or relictual (Saunders, unpublished obs.), with only one known collection from 1974.

The new species possesses floral morphology consistent with thrum flowers and thrum pollen of distylous species of *Waltheria*, suggesting that it is potentially distylous. It is placed in the *W. cinerescens* A. St.-Hilaire alliance (= *W. cinerescens* clade sensu Saunders, 1995; Saunders, unpublished phylogenetic analysis) close to *W. petiolata* K. Schumann in Martius.

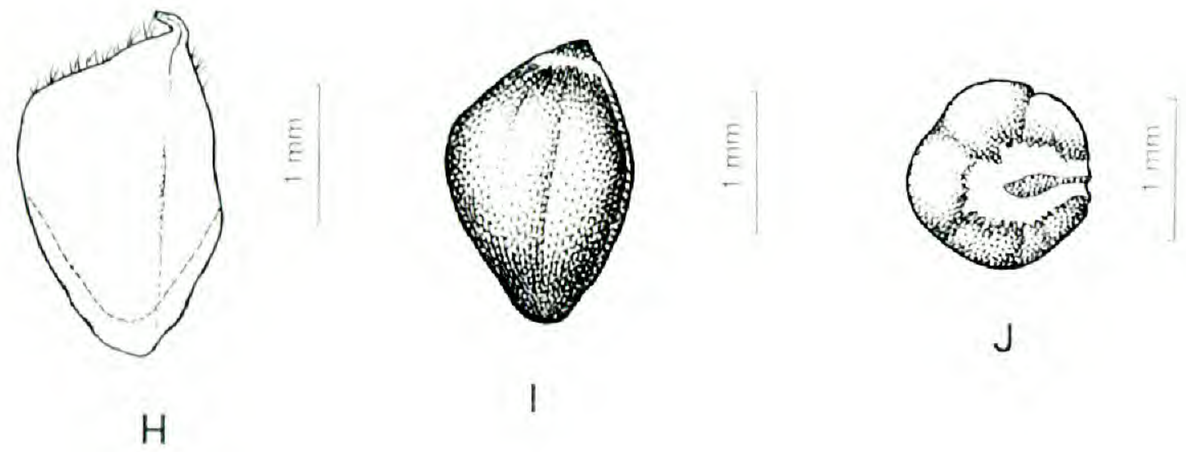
A key is provided to distinguish the new species from *Waltheria indica* L. s.l. seen from Belize (*Schipp 504*, NY; *Hill 20386*, NY; *Gentle 8457*, NY; and *Gentle 1054*, NY). *Waltheria indica*, as used in America, is not monophyletic (Cristóbal et al., 2005; Saunders, 2005) and needs more study.

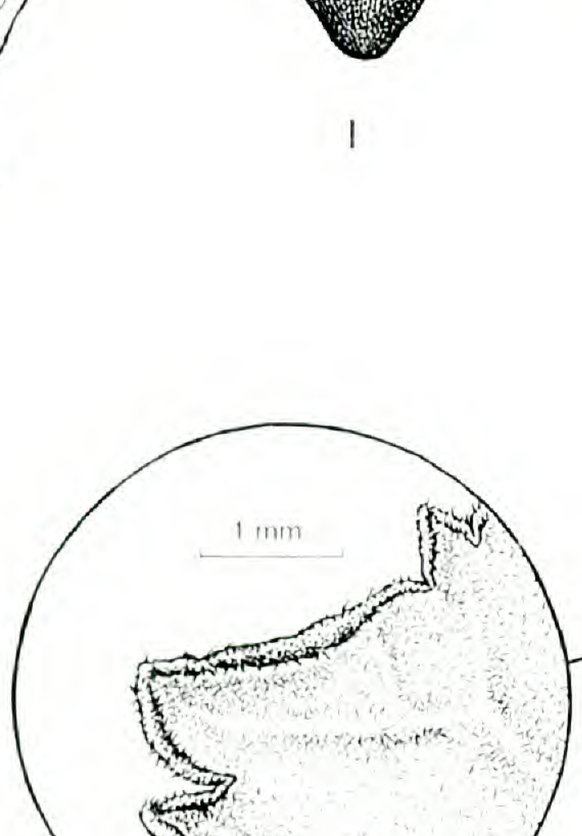
Waltheria belizensis J. G. Saunders, sp. nov. TYPE: Belize. Cayo District: Mt. Pine Ridge, 4.5 mi. S of Blancaneaux Lodge, 29 Jan. 1974, *John D. Dwyer & R. L. Liesner 12292* (holotype, MO 2248285). Figures 1, 2A–G.

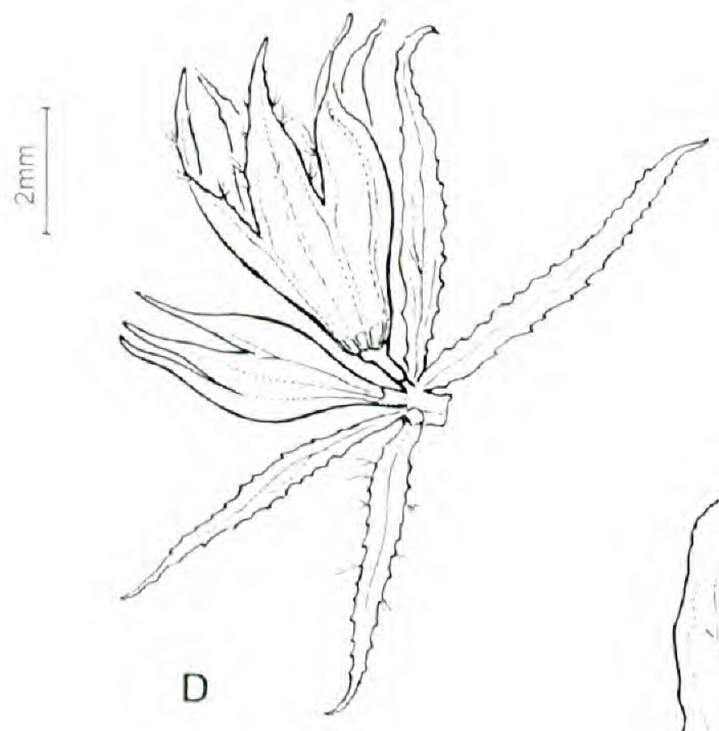
Haec species *Waltheriae petiolatae* affinis, sed pedicellis florum praesentibus; pubescentia vegetativa minuta, adpressa, rigida, ferrugineo-hyalina; foliorum nervis lateralibus pluribus (8 ad 13 paria) et dentibus marginalibus revolutis; aspectu apicali seminis minus lobato et cuticula seminali minus pustulata differt.

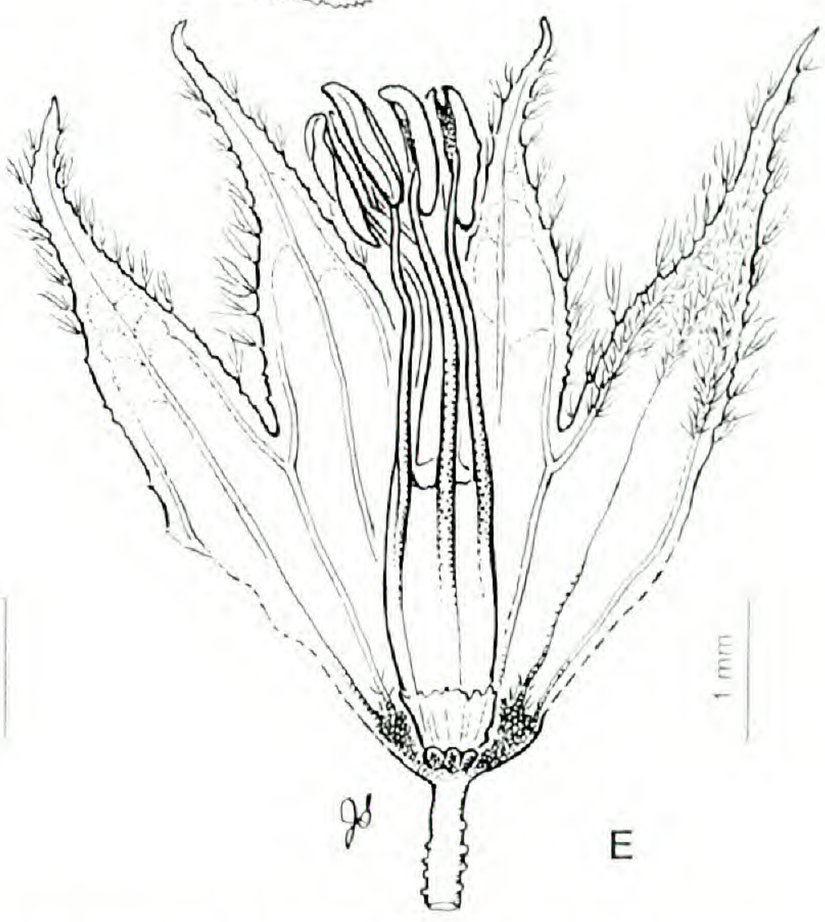
Shrubs ca. 1 m tall; stems straight, terete, subfoliose apically, completely beige-covered; vestiture 2-tiered, the trichome overlayer sparse, deciduous, stellate-tomentose, the trichomes stalked, the radii spreading, twisted at tips, thinner and longer than underlying ones, to 0.5 mm, the underlayer densely stellate-tomentulose, persistent, the radii 10 to 12, 0.2(0.4) mm, rigid, appressed, conical, hyaline tinged ferruginous, brown contents basally; trichome stalks persistent after rays shed at times, 0.1–0.2(0.4) mm, castaneous, cylindrical to conical; cortex castaneous,

[1] Hermannieae, including *Waltheria*, formerly in Sterculiaceae s.l., is now placed along with Theobromateae, Byttnerieae, and Lasiopetaleae in the Byttnerioideae, basal to the Grewioideae, formerly in Tiliaceae, in an expanded Malvaceae s.l. (Bayer & Kubitzki, 2003; Whitlock et al., 2001).









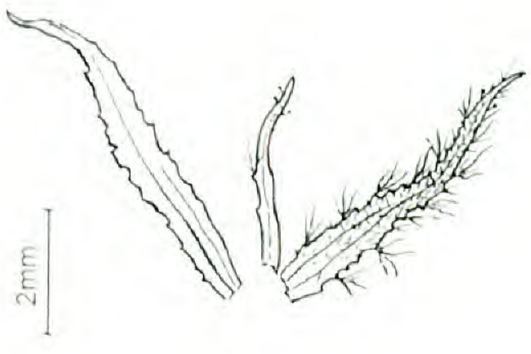


Figure 1. *Waltheria belizensis* J. G. Saunders. —A. Flowering branch. —B. Detail of revolute abaxial leaf margin. —C. Involucre, two stipules, and bradytelic leaf, from node below D. —D. Primary sympodial cyme with flower pair and two bracts above and below, developing cyme buds removed. —E. Thrum-like flower, opened, minus one calyx lobe, minus petals above base, minus pistil, with androecium and connate, adnate petal bases not removable, as irregular ring at base above lobed receptacle. —F. Petal, abaxial, missing base drawn in. —G. Pistil. —H. Capsule halved, interior view, showing extent of corneous endocarp from apex to lower broken line. —I. Seed, lateral view. —J. Seed, apical view. Based on the holotype, *Dwyer & Liesner 12292* (MO); B–J drawn by camera lucida by Saunders; A drawn and A–J inked by Francisco Rojas.

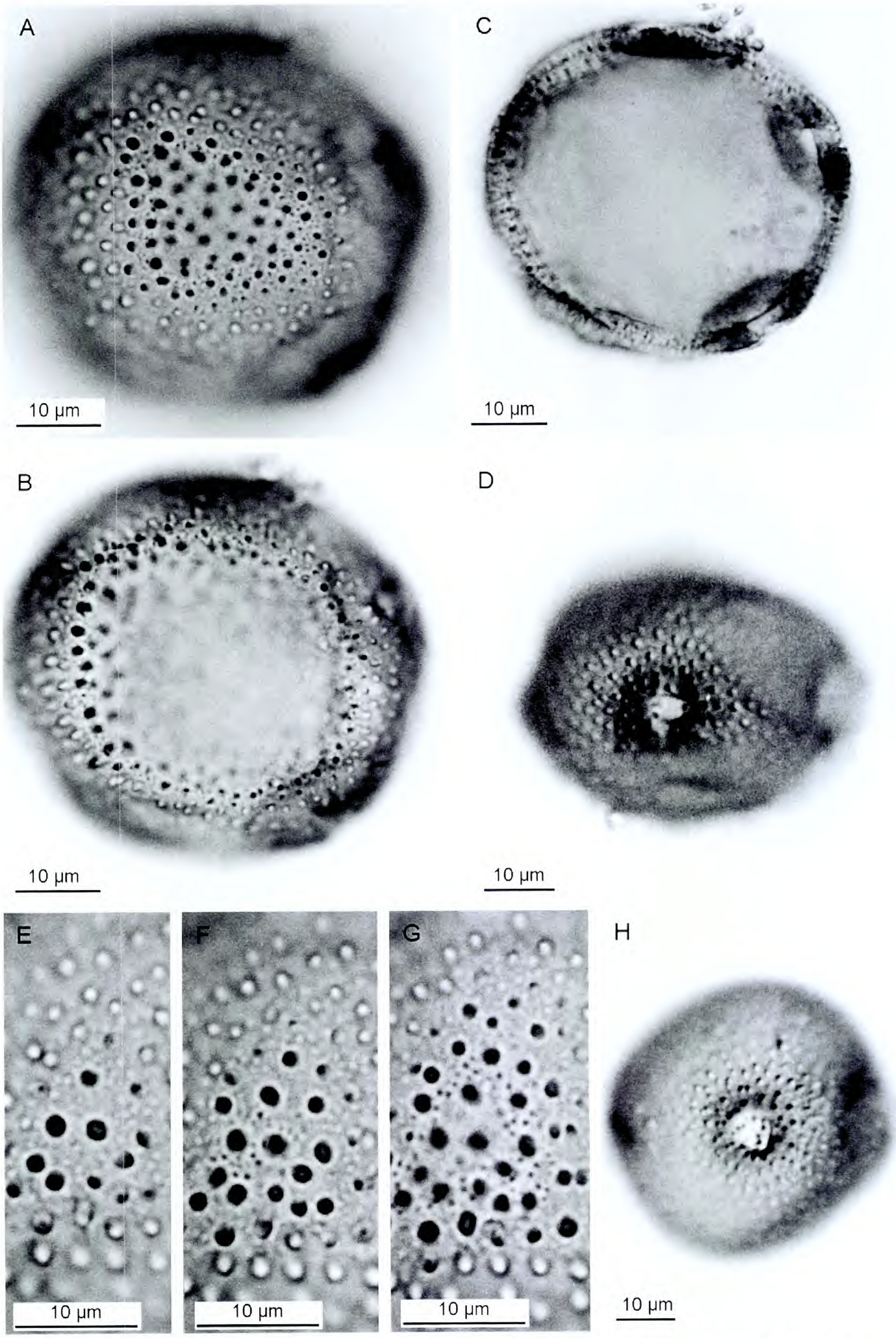


Figure 2. Thrum-like pollen morphology of *Waltheria belizensis* J. G. Saunders compared to thrum pollen aperture morphology of *W. petiolata* K. Schumann. A–G. *Waltheria belizensis* J. G. Saunders, from *Dwyer & Liesner 12292* (holotype, MO). —A–C. Lux obscuritas (LO) pattern of pollen grain in polar view. —D. Equatorial view of pollen grain with ectoaperture in Nomarsky focus. —E–G. LO pattern of pollen wall in polar view showing large dark spinules and smaller baculae. —H. *Waltheria petiolata* from *Saunders & Peixoto 3197* (SI), equatorial view of pollen grain with ectoaperture in Nomarsky focus.

glossy, finely anastomose, tuberculate from trichome stalks. Leaves with 2/5 phyllotaxy; leaf blades narrowly ovate to ovate-lanceolate, sublanceolate, 2–7 × 0.9–3.6 cm (L:W ratio 1.9–3.3:1), the bases rounded and entire, the apices widely acute-apiculate from an extended apical tooth, lateral margins crenate-mucronate, all of tooth margin revolute, the adaxial surfaces darker, grayish olive, pinkish brown–tinged when dry, slightly rugose, a little convex between lateral veins, more rugose and plicate marginally, the trichome overlayer sparse, subsessile, the trichome underlayer densely diminutively stellate-tomentulose, obscuring surface, the trichome radii fine, appressed, mostly 0.1(0.2) mm long, the abaxial surfaces gray-olive, minutely tomentose, obscuring surface, the trichome radii 0.3–0.4 mm, finer, whiter, more spreading compared to those above; veins 8 to 11(13) lateral pairs, 2 to 3 of these at base, 1 subcostal, first through third order veins impressed adaxially, raised abaxially; petioles (0.3)0.6–1.5(1.7) cm × 0.8–1 mm, woody, at base semi-terete, oblate at midlength, adaxially shallowly tapering-sulcate up to 1/4 twist at apex, the apex flattened above, slightly ridged on sides, the dorsal ridge very prominent, the cortex and vestiture as stem; stipules 3–5 × 0.3–0.6 mm, linear-lanceolate, adaxially short-pubescent with mostly simple and few-branched trichomes, with uniseriate filiform glandular trichomes at apex. Inflorescences pedunculate, axillary, compressed-deltoid, 1.5–5 cm diam., by Schumann's (1886: 52, 62) terms "decomposite, corymbiform-disposed cymes from cincinni brought together by many short, free naked branchlets"; peduncles 0.3–2 cm × 0.6–0.8 mm. Primary cyme sympodial: flower pairs subtended by 4 bracts; nodes between flower pairs bearing 3 bracteoles, apparently consisting of 2 stipules and a central teretely based bradytelic leaf with filiform glandular hairs; bracts subequal, 5–7.5 × 0.5–0.8 mm, lanceolate to linear, stellate-setulose abaxially and on margins, the margins subserrulate, the adaxial surface stellate-tomentulose. Flowers potentially distylous, only thrum-like flowers seen. Thrum-like flowers pedicellate; pedicels 0.4–1 × 0.2–0.3 mm, longest in fruit, tuberculate; calyx persistent, turbinate, 5–6 × 3–5 mm, divided halfway; laciniae lanceolate-acuminate, longitudinally inflexed and concave adaxially along midvein, 2.7–3.8 × 1–1.2 mm, with lateral veins subcostal, with midvein not prominent, the areoles obscure, puberulent within above base with simple and bifurcate straight acropetal hairs to 0.4 mm, short-villose with flagellate hairs at apices; calyx tube inside faintly veined between non-prominent lateral veins and midvein, the lateral veins not adjoined 0.3 mm below sinuses, subglabrous, a few simple trichomes above nectaries; nectary 0.8 mm; corolla yellow, the base gamopetalous and tubular for 0.4 mm with claw dissecting away only above connate portion adnate to staminal tube (Fig. 1E); petals maturing last, opposite stamens in early stages, becoming subopposite by growth of stamen tube, 4.7–6 × 1.2–1.5 mm; lamina narrowly obovate, obovate-oblong, the base usually gradually attenuate, the apex rounded and retuse, where a few minute hairs (simple, V-shaped, 0.2 mm) occur, hirsute within for 2/3 length above claw, a few hairs above, hairs to 0.4 mm, outer surface with minute appressed-stellate hairs scattered over veins (radii 10 to 20, 0.2 mm long), primary to secondary veins a little thick except near margins; claw ca. 1.2 × 0.6 mm, alate, undulate at apex, adnate for 0.4 mm basally to stamen tube, vein strap-like, cuneate; thrum-like stamens 5.5 mm long; stamen tube 1.7 mm (1/3 length), slightly imparipinnate, semitransparent with filaments thickened mid-length to apex; free filaments 3.3 mm, thick, darker-colored, glabrous; anthers oblong, 0.8–1 mm, the apex incised, connective dark; pistil 4 mm; ovary apex velutinous, with hairs to 1 mm; style filiform (oblate in transection), densely hirsute to apex; stigma penicillate, hemi-globose, 1.2 × 1.8 mm, with ca. 30 branches 0.8–1 mm, the column 0.4 mm. Capsule loculicidal, inclined-turbinate, the apex curved and apiculate (near style), apex tomentose; endocarp thinly corneous almost to base (Fig. 1H), only membranous at base and laterally at sutures; seed in lateral view obovoid-rhomboid, 1.8–1.9 × 1.2–1.3 mm, apex lacking apical ridge, undulations, or sulci, in apical view contour subpentagonal with each 1 of the 3 anterior lobe faces obtuse-rounded, similar, the posterior face truncate; strophiole calyptrate, red, 0.1 × 0.4 mm, very shallowly triangular; cuticle pusticulate and ochre apically, brown and striate-foveolate below to base; testa castaneous, shiny.

Pollen of thrum-like flowers (N = 15 except as noted): exine spinulose, apertures 5 to 6 (average 5.2, N = 113), zonocolpororate, colpus index (polar axis/colpus length) = 3.9, 49.3 × 51.8 µm, polar diameter/equatorial diameter (P/E) ratio = 0.95, oblate-spheroidal, colpi 12.6 × 2.5 µm, baculae ca. 0.8 µm, spinulae ca. 1 µm, ora lalongate, 4 × 12.8 µm (N = 10). Figure 2A–G.

Distribution and habitat. From extensive museum material examined without any other examples of *Waltheria belizensis* seen, it appears to be a restricted endemic to the Mountain Pine Ridge (MPR) National Forest Reserve situated along the northern drier slopes of the Maya Mountains in the Cayo District of Belize. The single locality known, 4.5 km south of Blancaneaux Lodge, occurs at or near the Douglas

D'Silva Forest Station (16°58′0N, 88°58′60W), situated at 495 m elevation, with an annual rainfall of 1550 mm and seasonally dry February through May (Falling Rain Genomics, 2006; Casado Internet Group, 2006). The Douglas D'Silva Forest Station, which was previously called the Augustine Forest Station, borders savanna vegetation class 17: Pine forest, savanna class 19: Transitional pine, grass, and palmettos, and savanna class 20: Open grass (Penn et al., 2004: 37–39; associated species given there) in a zone characterized by Balick et al. (2000: 2) as "highly weathered, nutrient-poor soils of igneous and metamorphic origin."

Other MPR plant endemics. The MPR Reserve is of interest for its physical and historical geology, isolated grass and pine savanna (Penn et al., 2004; Casado Internet Group, 2006), and potential for endemism (Balick et al., 2000), raising the question of whether the savanna there has been long maintained (see Cole, 1982). Because estimates for the number of plant endemics present within and limited to the park were not given in the literature, a list was compiled. Updating distributions (W3TROPICOS, 2006) for the 41 plant species of listed country endemics provided by Balick et al. (2000), combined with other data in Balick and Johnson (1994), Penn et al. (2004), and the new data for *Waltheria belizensis*, provides data that nine of the 38 Belizean flora endemic species considered here (nearly 24%) are present within the reserve, and that four of them (10% of Belizean plant endemics) are restricted to the MPR reserve, which has an area of nearly 200 square miles (among 18,000 square miles in Belize) and an elevation ranging from 394 to 3336 m (Balick et al., 2000; Casado Internet Group, 2006). Three species (ca. 8% of the country endemics) appear to be limited to the Douglas D'Silva Forest Station–Blancaneaux Lodge zone: (1) *Waltheria belizensis* is calculated to belong to class 19 at 100 m (cf. the electronic version of the Penn et al. (2004) vegetation map (Lone Aagesen, pers. comm., 2006)), (2) *Mimosa pinetorum* Standley (W3TROPICOS, 2006), and (3) *Syngonanthus bartlettii* Moldenke (W3TROPICOS, 2006) is cited as endemic to class 20 (Penn et al., 2004) and its present country endemic status is confirmed (N. Hensold, pers. comm., 2006). *Koanophyllon sorensenii* R. M. King & H. Robinson is also contained within the reserve limits, but *Axonopus ciliatifolius* Swallen, primarily from the Douglas D'Silva Forest Station–Blancaneaux Lodge zone, shows one collection in another district. Other country endemics are broadly present within the reserve, but not limited to it: *Anemia bartlettii* Mickel, *Schippia concolor* Burret, *Zinowiewia pallida* Lundell, and *Telanthophora bartlettii* H. Robinson & Brettell. This apparent high endemism for the MPR reserve needs assessment.

Several species at the MPR reserve are here considered excluded from country endemic status: *Galactia anomala* Lundell (W3TROPICOS, 2006; Peréz et al., 2005: 94), *Calyptranthes bartlettii* Standley, and *Metastelma stenomeres* (Standley & Steyermark) W. D. Stevens. Another species that has not been found at the MPR reserve is also excluded: *Piper schippianum* Trelease & Standley (W3TROPICOS, 2006).

Key to the Species of *Waltheria* in Belize

1a. Inflorescences to 4.5 cm diam., in age decomposite from many naked branchlets becoming diffuse at base with their cincinni brought closely together forming a compressed-deltoid, flat-topped, corymbiform cluster; leaves with surfaces obscured on both sides, pale gray-olive, tomentulose above with minute appressed-stellate trichomes 0.1–0.2 mm long, tomentose below, with 8 to 13 pairs of lateral veins; flowers thrum-like, possibly pin-like, pedicellate (0.4–1 mm long); calyx divided halfway, the laciniae 2.7–3.8 mm long, lanceolate-acuminate . . . . . *W. belizensis*

1b. Inflorescences to 1.5–2.5 cm diam., composite, condensed, not naked, usually sympodial from base to tip, rarely a little lax at base; leaves with adaxial or both surfaces visible, pubescent to tomentose and brown (dried) above, tomentose below, both sides with stellate, rarely simple, trichomes 0.5–1 mm long, with 3 to 8(9) pairs of lateral veins; flowers homostylous, sessile; calyx lobed less than halfway, the lobes 1–3 mm long, triangular. . . . . *W. indica* s.l.

Relationships. This new species is placed within *Waltheria* sect. *Waltheria* as formerly circumscribed (Schumann, 1886) within the *W. cinerescens* A. St.-Hilaire species alliance (Saunders, 1995) by its penicillate stigma (termed fan-plumose in Saunders, 1993) and capsule with mostly complete corneous endocarp. It resembles *W. petiolata* in its decomposite inflorescence, its calyx laciniae in every aspect, its indented apical petal margins, and especially by its seed shape that is subpentagonal in apical view and subrhomboidal in lateral view. For the characters that distinguish the two species, see Table 1. *Waltheria petiolata* is a thicket-forming, apparently rare species occurring on morros or restinga in or near Rio de Janeiro city, Brazil (Saunders, 1995). Important differentiating characters are given below.

Key between Related Species

1a. Stems becoming tomentulose, with all trichome rays 0.2–0.5 mm long, in the underlayer stout, appressed, almost straight, hyaline-ferrugineous; leaf teeth margins revolute; leaf lateral vein pairs 8 to 13; inflorescence corymbiform-decomposite; flowers pedicellate; petal apical margins retuse

Table 1. Distinguishing characters between *Waltheria belizensis* and *W. petiolata*.

Character	*W. belizensis*	*W. petiolata*
Stem		
Vestiture	tomentulose	tomentose
Trichomes	rays 0.1–0.3(–0.5) mm, ferrugineous-tinged, brown contents at base, straight, a little curved at times	rays 0.5–1 mm, hyaline, twisted apically
Leaves	concolorous, slightly darker above	discolorous, much darker above
Adaxial suface	dark gray-olive; surface obscured	bright green (fresh), red-brown (dried); surface visible
Abaxial surface	densely puberulent, pale gray-olive; surface obscured	soft tomentose-velutinous, white; surface visible
Teeth	revolute entire margin	flat
Lateral veins	8 to 13 pairs	6 to 8 pairs
Inflorescence	decomposite-corymbiform	decomposite-umbelliform
Flower pedicels	present	absent
Petal apical margins	retuse, scant pubescent, a few simple and V-shaped thin hairs 0.2 mm at center	emarginate, short-bearded longer, to 0.3 mm, across 3/4 of margin
Stamen free filaments	glabrous	scant hirsute
Capsule apicula	oblong	narrowly triangular
Seed (apical view)	all anterior lobes obtuse-rounded, similar	anterior 3 lobes pronounced, middle one obtuse-angled
Cutiele pusticula	minute, crowded at very apex	prominent, scattered on upper 1/3 and at raphe

with a few central thin hairs 0.2 mm; capsule apicula oblong and recurved 15°; seed obscurely lobed laterally in apical view; cuticle slightly pusticulate . . . . . *W. belizensis*

1b. Stems tomentose, with trichome rays 0.5–1 mm long, fine, spreading, twisted, hyaline to white; leaf teeth margins flat; leaf lateral vein pairs 6 to 8; inflorescence umbelliform-decomposite; flowers sessile; petal apical margins emarginate with similar hairs but more widely distributed across apex, the hairs to 0.3 mm; capsule apicula narrowly triangular and recurved 45°; seed markedly lobed anteriorally and laterally in apical view; cuticle pusticulate . . . . . *W. petiolata*

Relationships pertinent to breeding system status and biogeography. Except for *Waltheria rotundifolia* Schrank, disjunct from Brazil to southern North America, and *W. glabra* Poiret, from the Antilles, which both appear to be more derived by their pollen (Köhler, 1971, 1976), the *W. cinerescens* alliance (= *W. cinerescens* clade, Saunders, unpublished phylogenetic analysis) is composed of species narrowly endemic within Brazil. The portion of the clade containing *W. petiolata* includes *W. ackermanniana* K. Schumann, which is sister to *W. eriocladа* DC.; *W. eriocladа*, which is sister to *W. glazioviana* K. Schumann; and *W. glazioviana*, which is sister to *W. petiolata*. *Waltheria ackermanniana*, *W. eriocladа*, and *W. glazioviana* are all from Brazil. All of these phyletic neighbors are distylous except for *W. eriocladа*; *W. eriocladа* is potentially distylous but as yet is too poorly known. Those four species share the character combination of serrulate linear bracts, truncate pin stamen tubes, and darkened anther connective (Saunders, 1993, 1995, unpublished phylogenetic analysis). However, although it is suggested by phylogeny, by the number of distylous species in *Waltheria* (ca. 84%) (Saunders, 1993, 1995) and its putative sister genus *Melochia* L. (approximately 74%, Goldberg, 1967), and by its spinulose pollen found to be perfectly correlated thus far with thrums of distylous species within the genus, fieldwork is necessary to determine whether only thrum-like plants of *W. belizensis* are present or if pin plants are also present at the type locality in isoplethic or anisoplethic proportions. If only thrum-like plants occur, the breeding system of the new species would be considered to be derived monomorphic thrum rather than distylous, which is encountered less frequently than derived monomorphic pins (Ganders, 1979: 629).

Discussion of isotypes and Waltheria glomerata *in Belize.* Two duplicate specimens of *Waltheria belizensis*, now unmarked isotypes, were first identified and distributed to unrecorded locations not yet apparent, and the collection *Dwyer & Liesner 12292* was cited (Dwyer & Spellman, 1981) as the only occurrence of *W. glomerata* C. Presl in Belize. Balick et al. (2000) excluded *W. glomerata* from the Belize checklist. Other results concur that *W. glomerata* lacks collections known from Belize (Saunders, 1993, 1995, unpublished data). That species is distant by its clavate-fimbriate stigma and capsule lacking hardened endocarp (Saunders, 1993).

Pollen of Waltheria belizensis *and* W. petiolata. Köhler's (1971, 1973, 1976) pollen studies of the genus have established the most understanding of evolution within the genus. All spinulose pollen encountered within the palynologically well-studied genus belongs only to thrum floral morphs; all thrums have spinulose pollen. Pin morphs, homostylous morphs, or homostylous species have pollen with reticulate exines, different grain shapes, smaller grain size, and fewer average apertures with longer colpi (Kohler, 1971, 1973, 1976; Saunders, 1993, 1995). Interspecific pollen comparisons are made by morph type. Pollen of a *W. petiolata* thrum collection was newly studied for comparison to *W. belizensis* thrum-like pollen because the previous report (Köhler, 1971) was based upon a misidentified collection (*Macedo 3199*, S, specimen seen but species identity still uncertain). Thrum pollen of *W. petiolata* is spinulose, apertures 5 to 6(7) (average 5.9 for N = 50), zonocolporate, grains 49.3 × 52 μm, P/E ratio = 0.94, oblate-spheroidal, colpi 9.5 × 2 μm (N = 10), endexine at pores 2.9 μm, ca. 1.2 μm otherwise, bacula ca. 0.6 μm, spinulae 1.2 μm long × 1.3 μm diam., ora 4.4 × 11.2 μm wide (*Saunders & Peixoto 3197* thrum SI, N = 10).

Thrum-like pollen of *Waltheria belizensis* (Fig. 2A–G) primarily differs from thrum pollen of *W. petiolata* (Fig. 2H) by an average aperture number of 5.2 versus 5.9; a colpus index of 3.9 versus 5.2; colpus length of 12.6 μm versus 9.5 μm; and a colpus width of 2.5 μm versus 2.0 μm, with colpi less reduced, longer, and a little more extended beyond the pore, and the annulus less thickened and less protruding internally around the pore. Köhler (1976) discovered and illustrated the trend toward increased number of pollen apertures and shortening of ectoaperture size and colpus length, with a thickening of the endo-aperture pore borders operating within both morphs among species of the genus. For the new species, we follow Köhler's (1976: 153) interpretations for the same trends of aperture evolution in the genus in concluding that the thrum-like pollen of *W. belizensis* is more plesiomorphic with respect to its lower average aperture number and longer colpus length of apertures compared with thrum pollen of *W. petiolata*.

If distyly is confirmed in *Waltheria belizensis*, this important character suggests that the shared ancestor of *W. belizensis* and *W. petiolata* had a broader American distribution and either that the South American species evolved faster or that incremental past migration was from North America to South America but not vice versa in recent times, even though its clade of mostly restricted endemics is now concentrated in central and eastern Brazil (Saunders, 1995). If *W. belizensis* is distylous, its reproductive biology favors either of the first two hypotheses, but not long-distance dispersal from South America to North America. This is because in distylous *Waltheria* widely disjunct populations are found only rarely, because they do not become established readily after long-distance dispersal unless both morphs are dispersed or self-incompatibility is lost or weakened (Saunders, 1993, 1995, 2005; Cristóbal et al., 2005), which is not indicated by the spinulose pollen in *W. belizensis*. For most distylous *Waltheria* sampled, isoplethic ratios of pin and thrum morphs, signaling strong self-incompatibility, were usually present (Saunders, unpublished data). In addition, *W. belizensis* and its close relatives lack long setae on the exterior calyx that might function as the exozoochoric mechanism for its long-distance dispersal; these setae are present in the few disjunct species of *Waltheria*. Consequently, it is Saunders's hypothesis, based upon her present understanding of the genus, that *W. belizensis* might be a relictual species.

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New Combinations in *Mandevilla* Lindley (Apocynaceae)

André Olmos Simões and Luiza Sumiko Kinoshita*

Departamento de Botânica, Universidade Estadual de Campinas, Cidade Universitária Zeferino Vaz, Caixa Postal 6109, CEP 13083-970, Campinas, São Paulo, Brazil.
*Author for correspondence: simoes@systbot.unizh.ch; luizakin@unicamp.br

Mary E. Endress

Institute of Systematic Botany, University of Zürich, Zollikerstrasse 107, CH 8008, Zürich, Switzerland. mendress@systbot.unizh.ch

Abstract. Historically, taxonomic delimitation of *Mandevilla* Lindley, a large Neotropical genus of Apocynaceae, has been controversial. Two competing classifications were proposed by Woodson (1933) and Pichon (1948), the former now being widely accepted by taxonomists in the family. Recent phylogenetic studies, however, support the monophyly of *Mandevilla* sensu Pichon rather than sensu Woodson, the latter being paraphyletic with respect to *Quiotania* Zarucchi, *Macrosiphonia* Müller Argoviensis, and *Telosiphonia* (Woodson) Henrickson. Based on the principle of monophyly, we here re-establish Pichon's classification and include *Quiotania*, *Macrosiphonia*, and *Telosiphonia* as synonyms of *Mandevilla*. Three new combinations are made here: *Mandevilla hesperia* (I. M. Johnston) A. O. Simões, L. S. Kinoshita-Gouvêa & M. E. Endress, *M. nacalpulensis* (Felger & Henrickson) A. O. Simões, L. S. Kinoshita-Gouvêa & M. E. Endress, and *M. undulata* (C. Ezcurra) A. O. Simões, L. S. Kinoshita-Gouvêa & M. E. Endress; *Q. colombiana* Zarucchi is newly synonymized with *M. ligustriflora* Woodson; and a lectotype is designated for *M. martii* (Müller Argoviensis) Pichon.

Key words: Apocynaceae, *Macrosiphonia*, *Mandevilla*, *Quiotania*, *Telosiphonia*.

Mandevilla Lindley is the largest genus of Mesechiteae (Apocynaceae, Apocynoideae), with about 140 to 150 species distributed throughout the Neotropics (Woodson, 1933; Sales et al., 2006; Simões et al., 2006). Historically, *Mandevilla* has been one of the most challenging genera for taxonomists working on Neotropical Apocynaceae, not only in terms of its circumscription, but also in determining its relationships with other genera of the tribe.

Woodson defined the currently accepted circumscription of *Mandevilla* in 1933, broadening its limits by including several other genera in its synonymy (e.g., *Laseguea* A. DC. and *Dipladenia* A. DC. (de Candolle, 1844), *Amblyanthera* Müller Argoviensis and *Heterothrix* Müller Argoviensis (Müller Argoviensis, 1860), and *Eriadenia* Miers, *Micradenia* Miers, *Homaladenia* Miers, and *Angadenia* Miers, p.p. (Miers, 1878)). Woodson recognized the close affinities of *Mandevilla* and *Macrosiphonia* Müller Argoviensis, but maintained the generic status of the latter due to differences in habit, flowering time, and stylehead structure. Woodson also proposed a subgeneric classification for *Macrosiphonia*, including the North American species in subgenus *Telosiphonia* Woodson and the South American species in subgenus *Macrosiphonia* Woodson.

Pichon proposed a revised classification of *Mandevilla* in 1948. He broadened the circumscription of the genus by including *Macrosiphonia* in its synonymy, arguing that the distinguishing characters used by Woodson (1933) for the generic recognition of *Macrosiphonia* were inconsistent and arbitrary. He also placed Woodson's subgenera *Macrosiphonia* and *Telosiphonia* in two distinct sections, *Megasiphon* Pichon and *Telosiphonia* Pichon, respectively, and did not consider them as each other's closest relative. Pichon's classification, however, has not caused a major impact among taxonomists of Neotropical Apocynaceae, and Woodson's circumscription of *Mandevilla* still prevails.

Since Pichon's (1948) revised classification, only a few taxonomic studies of *Mandevilla* and related genera have been published. In 1991, Zarucchi described a new monotypic genus, *Quiotania*, based on two collections from Antioquia, Colombia. He stated that it is clearly a member of Mesechiteae, and that it would key out to *Mandevilla* using Woodson's 1938 key in the *North American Flora*. In the light of having only flowering material available, the distinguishing character for *Quiotania* given by Zarucchi (1991) was its lack of a pronounced corolla tube. In 1996, Henrickson elevated Woodson's subgenus *Telosiphonia* to generic status based on characters such as inflorescence type, style head structure, and pollen size.

Recently, Simões et al. (2004) provided the first phylogenetic study of the Mesechiteae. Their results showed that *Macrosiphonia* and *Telosiphonia* are strongly supported as nested within a clade formed by species of *Mandevilla*, which largely corresponds to the circumscription of *Mandevilla* proposed by Pichon (1948), but not by Woodson (1933). These preliminary results were later confirmed in a second phylogenetic study based on a broad taxon sampling of *Mandevilla* (Simões et al., 2006). In addition, the status of *Quiotania* was evaluated, and that genus was also found to be nested within *Mandevilla*.

In the light of this strong phylogenetic evidence and following the principle of monophyly, we here propose nomenclatural changes to include *Macrosiphonia*, *Quiotania*, and *Telosiphonia* in the synonymy of *Mandevilla*. Most of the required changes were already made by Pichon (1948), and these are enumerated here. The new combinations and synonyms proposed here merely complete the process.

Mandevilla Lindley, Edwards's Bot. Reg. 26: pl. 7. 1840, nom. cons. TYPE: *Mandevilla laxa* (Ruiz & Pavón) Woodson.

Macrosiphonia Müller Argoviensis in Mart., Fl. Bras. 6(1): 137. 1860. *Macrosiphonia* subg. *Eumacrosiphonia* Woodson, Ann. Missouri Bot. Gard. 20: 784. 1933. TYPE: *Macrosiphonia velame* (A. Saint-Hilaire) Müller Argoviensis (lectotype, designated by R. E. Woodson, 1933: 778).

Quiotania Zarucchi, Novon 1: 33. 1991. Syn. nov. TYPE: *Quiotania colombiana* Zarucchi.

Telosiphonia Henrickson, Aliso 14: 179. 1995 [1996]. Syn. nov. *Macrosiphonia* subg. *Telosiphonia* Woodson, Ann. Missouri Bot. Gard. 20: 778. 1933. TYPE: *Echites hypoleucus* Bentham [= *Telosiphonia hypoleuca* (Bentham) Henrickson] (lectotype, designated by J. Henrickson, 1995 [1996]: 184).

For complete synonymy, see Woodson (1933) and Pichon (1948).

1. **Mandevilla brachysiphon** (Torrey) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 106. 1948. Basionym: *Echites brachysiphon* Torrey, Rep. U.S. Mex. Bound., Bot. 2(1): 158. 1859. *Macrosiphonia brachysiphon* (Torrey) A. Gray, Syn. Fl. N. Amer. 2(1): 83. 1878. TYPE: U.S.A. Arizona: 1851, *C. Wright 1655* (holotype, BM not seen; isotypes, MO, US).

Telosiphonia brachysiphon (Torrey) Henrickson, Aliso 14: 187. 1995 [1996]. TYPE: Mexico. Sonora: gravelly hillside, San Bernardino, Aug. 1852, *G. Thurber 764* (lectotype, designated by J. Henrickson (1995 [1996]: 186), NY; isotype, GH not seen).

2. **Mandevilla hesperia** (I. M. Johnston) A. O. Simões, L. S. Kinoshita-Gouvêa & M. E. Endress, comb. nov. Basionym: *Macrosiphonia hesperia* I. M. Johnston, Proc. Calif. Acad. Sci., ser. 4, 12: 1125. 1924. *Telosiphonia hesperia* (I. M. Johnston) Henrickson, Aliso 14: 191. 1995 [1996]. TYPE: Mexico. Baja California Sur: cliffs back of Puerto Ballandra, Carmen Island, Gulf of California, 21 May 1921, *I. M. Johnston 3807* (holotype, CAS not seen; isotypes, US, US photo MO).
3. **Mandevilla hypoleuca** (Bentham) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 106. 1948. Basionym: *Echites hypoleucus* Bentham, Pl. Hartw. 23. 1839. *Macrosiphonia hypoleuca* (Bentham) Müller Argoviensis, Linnaea 30: 452. 1860. *Rhodocalyx hypoleucus* (Bentham) Miers, Apocyn. S. Am. 140. 1878. *Telosiphonia hypoleuca* (Bentham) Henrickson, Aliso 14: 185. 1995 [1996]. TYPE: Mexico. [Aguas Calientes: Rosa de San Juán dictus, in petrosis Aquas Calientes, 1837–1838, fide McVaugh, 1970], *K. T. Hartweg 193* (holotype, P; isotypes, GH not seen, NY, W not seen, W photo MO not seen).
4. **Mandevilla lanuginosa** (M. Martens & Galeotti) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 106. 1948. Basionym: *Echites lanuginosus* M. Martens & Galeotti, Bull. Acad. Sci. Roy. Bruxelles 11(1): 357. 1844. *Rhodocalyx lanuginosus* (M. Martens & Galeotti) Miers, Apocyn. S. Am. 139. 1878. *Macrosiphonia lanuginosa* (M. Martens & Galeotti) Hemsley, Biol. Cent.-Amer., Bot. 2(10): 316. 1881. *Telosiphonia lanuginosa* (M. Martens & Galeotti) Henrickson, Aliso 14: 189. 1995 [1996]. TYPE: Mexico. Hidalgo: "crôit sur les versants calcaires et schisteux du gran ravin de Mextitlan au NNE de México," 6000 ft., "18 Sep.," *H. Galeotti 1594* (type, BR).
5. **Mandevilla ligustriflora** Woodson, Ann. Missouri Bot. Gard. 37: 404. 1950. *Quiotania ligustriflora* (Woodson) J. F. Morales, nom. ined. TYPE: Ecuador. Zamora-Huaico: ca. 6 km SE of Loja, alt. 2300–2400 m, 3 July 1947, *R. Espinosa 1547* (holotype, MO).

Quiotania colombiana Zarucchi, Novon 1: 33. f. 1. 1991. Syn. nov. TYPE: Colombia. Antioquia: Mpio. de La Unión, Km 33 of road Sonsón–La Unión (23 km from La Unión), 5°52′N, 75°08′W, alt. 2330 m, 8 Dec. 1986 (fl), *J. L. Zarucchi & N. Bedoya 4510* (holotype, HUA-33422 not seen; isotypes, COL not seen, K not seen, MO, US).

During preparation of the Apocynaceae treatment for the *Flora of Ecuador*, the second author received two specimens of an undetermined species of *Mandevilla*. After detailed examination, these speci-

mens were identified as *M. ligustriflora*, a species described by Woodson in 1950 and known only from the type collection. In Simões et al. (2004), *M. ligustriflora* was clearly nested in *Mandevilla*, and with the increased taxon sampling in a second phylogenetic study (Simões et al., 2006) this relationship was also strongly supported. At the same time, however, a strong morphological similarity to the single species of *Quiotania*, *Q. colombiana*, was noticed. Both species are vines with unbranched, pseudo-umbellate inflorescences bearing white to pale yellow flowers that lack a pronounced corolla tube. By comparing our specimens with photocopies of the type collection kindly provided by J. Zarucchi and the original descriptions of both *Q. colombiana* and *M. ligustriflora*, we determined that they are conspecific. We found no significant morphological differences between the two taxa, even in the length of the corolla tube (2.5–3 mm in *Q. colombiana* and 3–5 mm long in *M. ligustriflora*), which was the main character used by Zarucchi (1991) to distinguish *Quiotania* from *Mandevilla*. Therefore, we feel confident in adding *Quiotania* to the synonymy of *Mandevilla*.

6. Mandevilla longiflora (Desfontaines) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 107. 1948. Basionym: *Echites longiflorus* Desfontaines, Mém. Mus. Natl. Hist. 5: 276. 1819. *Macrosiphonia longiflora* (Desfontaines) Müller Argoviensis in Mart., Fl. Bras. 6(1): 140. 1860. TYPE: Brazil. "San Borja dans la province de Missionum," *A. de Saint Hilaire 2681* (holotype, P; isotype, US).

7. Mandevilla macrosiphon (Torrey) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 106. 1948. Basionym: *Echites macrosiphon* Torrey, Rep. U.S. Mex. Bound., Bot. 2(1): 158. 1859. *Telosiphonia macrosiphon* (Torrey) Henrickson, Aliso 14: 187. 1995 [1996]. TYPE: U.S.A. New Mexico: without locality, 1851–1852, *C. Wright 1664* (lectotype, designated by J. Henrickson (1995 [1996]: 187), NY; isotypes, GH not seen, US).

8. Mandevilla martii (Müller Argoviensis) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 107. 1948. Basionym: *Macrosiphonia martii* Müller Argoviensis in Mart., Fl. Bras. 6(1): 138. 1860. TYPE: Brazil. "In prov. Goyanensi," 1842, *G. Gardner 3312* (lectotype, designated here, NY; isotypes, P, SP, W, W photo F).

Echites virescens was originally published in 1824 by Saint-Hilaire based on a single collection (*Saint-Hilaire s.n.*, deposited at P). Stadelmeyer (1841) broadened the circumscription of *E. virescens* by adding a second collection (*Martius s.n.*, deposited at M) on its limits. In his treatment for the *Flora Brasiliensis*, Müller Argoviensis (1860) considered these two collections as representing distinct species from a new genus, *Macrosiphonia*. *Saint-Hilaire s.n.* was designated by him as the type specimen of *M. virescens*, and *Martius s.n* was included in the protologue of *M. martii*, together with two other collections (*Gardner 3312* and *Pohl 970*). Müller Argoviensis (1860), however, did not designate a holotype for *M. martii*, making it necessary to choose a lectotype from the three collections selected by him. We feel confident to designate *Gardner 3312* as the lectotype of *M. martii*, because this collection is a representative element of the taxon and duplicates are deposited in four herbaria.

9. Mandevilla nacapulensis (Felger & Henrickson) A. O. Simões, L. S. Kinoshita-Gouvêa & M. E. Endress, comb. nov. Basionym: *Telosiphonia nacapulensis* Felger & Henrickson, Aliso 14(3): 194, f. 4E–J, 5. 1995 [1996]. TYPE: Mexico. Sonora: Cañón nacapules, ca. 4 km N of Bahía San Carlos, 11 Aug. 1985, *R. S. Felger & M. A. Dimmitt 85-830* (holotype, ARIZ not seen; isotypes, GH not seen, MEXU not seen, NY, TEX).

10. Mandevilla petraea (A. Saint-Hilaire) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 107. 1948. Basionym: *Echites petraea* A. Saint-Hilaire, Mém. Mus. Natl. Hist. 12: 322. 1825. *Macrosiphonia petraea* (A. Saint-Hilaire) K. Schumann in Engler & Prantl, Nat. Pflanzenfam. 4(2): 168. 1895. *Macrosiphonia verticillata* (A. Saint-Hilaire) Müller Argoviensis in Mart., Fl. Bras. 6(1): 140. 1860. *Macrosiphonia verticillata* var. *petraea* (A. Saint-Hilaire) Müller Argoviensis in Mart., Fl. Bras. 6(1): 141. 1860. TYPE: Brazil. Rio Grande do Sul: "au milieu des rochers près l'Arroro del Rosario," 1816–1821, *A. de Saint Hilaire 2338* (holotype, P; isotype, P photo F not seen).

For complete synonymy, see Woodson (1933).

11. Mandevilla undulata (C. Ezcurra) A. O. Simões, L. S. Kinoshita-Gouvêa & M. E. Endress, comb. nov. Basionym: *Macrosiphonia undulata* C. Ezcurra, Hickenia 1(45): 243, f. 2. 1981. TYPE: Argentina. Missiones: Departamento Candelaria, Loreto, Jan. 1957, *R. Martinez Crovetto 8603* (holotype, BAB not seen; isotype, SI).

12. Mandevilla velame (A. Saint-Hilaire) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2, 20: 107. 1948. Basionym: *Echites velame* A. Saint-Hilaire, Bull. Sci. Soc. Philom. Paris 77. 1824. *Macrosiphonia*

velame (A. Saint-Hilaire) Müller Argoviensis in Mart., Fl. Bras. 6(1): 138. 1860. TYPE: Brazil. sine loc., 1816–1821, *A. de Saint-Hilaire s.n.* (type, P).

13. **Mandevilla virescens** (A. Saint-Hilaire) Pichon, Bull. Mus. Natl. Hist. Nat., sér. 2: 107. 1948. Basionym: *Echites virescens* A. Saint-Hilaire, Bull. Sci. Soc. Philom. Paris 77. 1824. *Macrosiphonia virescens* (A. Saint-Hilaire) Müller Argoviensis in Mart., Fl. Bras. 6(1): 139. 1860. TYPE: Brazil. "Province de Saint-Paul, Fortaleza," 1816–1821, *A. de Saint Hilaire s.n.* (holotype, P; isotype, P photo F not seen).

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Henrickson, J. 1996. Studies in *Macrosiphonia* (Apocynaceae): Generic recognition of *Telosiphonia*. Aliso 14: 179–195.

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Brasiliorchis: A New Genus for the *Maxillaria picta* Alliance (Orchidaceae, Maxillariinae)

Rodrigo B. Singer

Departamento de Botânica, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves 9500, Bloco IV, Predio 43432, Sala 207, Bairro Agronomia, CEP 91501-970, Porto Alegre, Rio Grande do Sul, Brazil. rbsinger1@yahoo.com

Samantha Koehler

Departamento de Botânica, Instituto de Biologia, Universidade Estadual de Campinas, Caixa Postal 6109, 13083-970, Campinas, São Paulo, Brazil. samantha.koehler@googlemail.com

Germán Carnevali

Herbarium CICY, Centro de Investigación Científica de Yucatán A. C., Calle 43, No. 130, Col. Chuburná de Hidalgo, 97200 Mérida, Yucatán, México. carneval@cicy.mx

Abstract. *Brasiliorchis* R. Singer, S. Koehler & Carnevali is here proposed to include the orchid species formerly recognized in the *Maxillaria picta* alliance, an orchid group mostly endemic to the Atlantic Rain Forest Biome, in south and southeastern Brazil. The new genus is supported by both morphological features and ongoing molecular studies. The new genus is easily diagnosed by its sulcate to ridged, bifoliate pseudobulbs and its long-lasting, campanulate, rewardless flowers. The pollinaria of these flowers are normally devoid of stipes. Formal diagnosis of the genus and 13 taxonomic combinations are presented: *Brasiliorchis barbozae* (Loefgren) R. Singer, S. Koehler & Carnevali, *B. chrysantha* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. consanguinea* (Klotzsch) R. Singer, S. Koehler & Carnevali, *B. gracilis* (Loddiges) R. Singer, S. Koehler & Carnevali, *B. heismanniana* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. kautskyi* (Pabst) R. Singer, S. Koehler & Carnevali, *B. marginata* (Lindley) R. Singer, S. Koehler & Carnevali, *B. phoenicanthera* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. picta* (Hooker) R. Singer, S. Koehler & Carnevali, *B. polyantha* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. porphyrostele* (Reichenbach f.) R. Singer, S. Koehler & Carnevali, *B. schunkeana* (Campacci & Kautsky) R. Singer, S. Koehler & Carnevali, and *B. ubatubana* (Hoehne) R. Singer, S. Koehler & Carnevali. Lectotypes are designated for *B. barbozae*, *B. chrysantha*, *B. heismanniana*, *B. phoenicanthera*, *B. picta*, and *B. polyantha*. A neotype is proposed for *B. consanguinea*. In addition, a key to distinguish *Brasiliorchis* from other sympatric bifoliate orchids within Brazilian Maxillariinae is presented.

Resumo. O gênero *Brasiliorchis* R. Singer, S. Koehler & Carnevali, é proposto para conter aquelas espécies de orquídeas antes incluidas na Aliança *Maxillaria picta*; um agrupamento primariamente endêmico do bioma Mata Atlântica, no Sul e Sudeste do Brasil. Este novo gênero é sustentado tanto por caracteres morfológicos quanto por estudos de biologia molecular em andamento. O novo gênero é facilmente diagnosticado pelos seus pseudobulbos bifoliados, sulcados a canaliculados e pelas suas flores campanuladas, duradouras e sem recompensas florais. Os polinários destas espécies normalmente carecem de estipes. Apresenta-se a diagnose formal do novo gênero, bem como treze novas combinaçoes taxonômicas: *Brasiliorchis barbozae* (Loefgren) R. Singer, S. Koehler & Carnevali, *B. chrysantha* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. consanguinea* (Klotzsch) R. Singer, S. Koehler & Carnevali, *B. gracilis* (Loddiges) R. Singer, S. Koehler & Carnevali, *B. heismanniana* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. kautskyi* (Pabst) R. Singer, S. Koehler & Carnevali, *B. marginata* (Lindley) R. Singer, S. Koehler & Carnevali, *B. phoenicanthera* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. picta* (Hooker) R. Singer, S. Koehler & Carnevali, *B. polyantha* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, *B. porphyrostele* (Reichenbach f.) R. Singer, S. Koehler & Carnevali, *B. schunkeana* (Campacci & Kautsky) R. Singer, S. Koehler & Carnevali e *B. ubatubana* (Hoehne) R. Singer, S. Koehler & Carnevali. São propostos lectótipos para *B. barbozae*, *B. chrysantha*, *B. heismanniana*, *B. phoenicanthera*, *B. picta* e *B. polyantha*. Propõe-se um neótipo para *B. consangui-*

nea. Além disto apresenta-se uma chave dicotômica para separar *Brasiliorchis* das outras orquídeas Maxillariinae bifoliadas brasileiras.

Key words: *Brasiliorchis*, *Maxillaria*, Maxillariinae, *Maxillaria picta* alliance, morphology, taxonomy.

The subtribe Maxillariinae (Orchidaceae) comprises a well-supported monophyletic assemblage of neotropical species (Whitten et al, 2000). However, generic delimitations within the subtribe are unconvincing and need significant improvement (Dressler, 1993). For that reason, a multidisciplinary task group (http://128.227.186.212/herbarium/max/people/people.htm) involving researchers from different countries and institutions was assembled to attempt a solution for this problem. The main goal of this project is to reconstruct a molecular phylogeny for the entire subtribe based on multiple DNA sequence data (M. Whitten, pers. comm.) in order to provide a solid framework to a more robust, phylogenetically acceptable, generic delimitation. Such a reliable phylogeny will allow the re-evaluation of the non-molecular characters that are currently used to distinguish the genera within Maxillariinae. A preliminary molecular cladogram based on the regions ITS 1–2, *matK*, and *atpB-rbcL* spacer, and 320 taxa is already available online (http://128.227.186.212/herbarium/max/phylogenetics/phylogenetics.htm). A simplified version of this cladogram is shown in Figure 1, with updated bootstrap values (M. Whitten, pers. comm.).

Some relevant recent findings deserve to be highlighted. The circumscription of the subtribe Maxillariinae was broadened to encompass the former subtribes Lycastiinae and Bifrenariinae (Whitten et al., 2000). Some Maxillariinae subgroups (or alliances, see Pabst & Dungs, 1977) formerly recognized under the large genus *Maxillaria* Ruiz & Pavón have been transferred to other genera on the basis of diagnostic morphological characters (Barros, 2002; Ojeda et al., 2005; Carnevali, in prep.). For example, Barros (2002) transferred most Brazilian species of the distinctive *M. discolor* Reichenbach alliance (sensu Pabst & Dungs, 1977) to the genus *Heterotaxis* Lindley. However, *Heterotaxis* sensu Barros (2002) was paraphyletic (Singer & Koehler, 2003, 2004); this problem was resolved by Ojeda et al. (2005), who expanded *Heterotaxis* to include the species of the *M. valenzuelana* Nash alliance (sensu Pabst & Dungs, 1977) plus other closely related species, thus rendering the genus monophyletic. Other smaller Maxillariinae subgroups related to *Heterotaxis* (sensu Ojeda et al., 2005) and currently placed in *Maxillaria* will soon be also recognized as distinct genera (Ojeda, pers. comm.).

An additional finding from these molecular studies of the Maxillariinae is that, in its former circumscription (Atwood & Mora de Retana, 1999), the genus *Maxillaria* is not monophyletic. Even after the removal of the peripheral species groupings above, it becomes evident from the topology of the most parsimonious cladograms that the genus *Maxillaria* in its former circumscription is grossly polyphyletic or paraphyletic. Several of the traditionally recognized genera in the conduplicate-leaved Maxillariinae (e.g., *Trigonidium* Lindley, *Mormolyca* Fenzl) are nested within the genus *Maxillaria* (Whitten et al., unpublished data; Fig. 1). Thus, a major generic realignment of the Maxillariinae is required.

Preliminary results based on combined, phylogenetic analyses of multiple sequence data for the subtribe Maxillariinae (regions ITS 1–2, *matK*, and *atpB-rbcL* spacer, 320 taxa, see Fig. 1) clearly indicate that species belonging to the *Maxillaria picta* Hooker alliance (sensu Singer & Koehler, 2004) form a well-supported (bootstrap = 100%, Fig. 1), monophyletic assemblage (Singer & Koehler, 2004; M. Whitten, pers. comm.). In addition, this group can be easily recognized by a distinctive set of morphological features, as shown below.

Traditionally, the *Maxillaria picta* assemblage has been considered a subgroup or section within the genus *Maxillaria* (Christenson, 2002; Hoehne, 1953; Pabst & Dungs, 1977; Pfizer, 1889; Senghas, 1996). The *M. picta* alliance falls outside (Fig. 1) the *Maxillaria* core, that subgroup within the Maxillariinae containing the type species of *Maxillaria* (*M. platypetala* Ruiz & Pavón). Instead, the *M. picta* alliance appears more closely related to a mainly Andean clade containing the *M. chartacifolia* Ames & C. Schweinfurth clade, plus the *Cryptocentrum* Bentham/*Anthosiphon* Schlechter clade. The *Cryptocentrum/Anthosiphon* clade holds species with several floral and vegetative autapomorphies and has no obvious morphological similarity (either in floral or vegetative features) to the *M. picta* alliance. This clade is characterized by unique features such as a conspicuous nectary or spur composed of the sepal's lateral bases and the roof of an extremely elongated column-foot that encloses the backward elongated base of the labellum. Furthermore, the pollinarium is unique in having the stipe reduced to a strap-like, inconspicuous band of tissue, with a short, somewhat amorphous or oblong viscidium. Most species of the *Cryptocentrum/Anthosiphon* clade are vegetatively reduced, and all but two species are monopodial. A few species display life history traits of twig-epiphytes (Carnevali, 1996, 2001).

The node that links both clades (the *Maxillaria picta* alliance and the *M. chartacifolia/Cryptocentrum/Antho-*

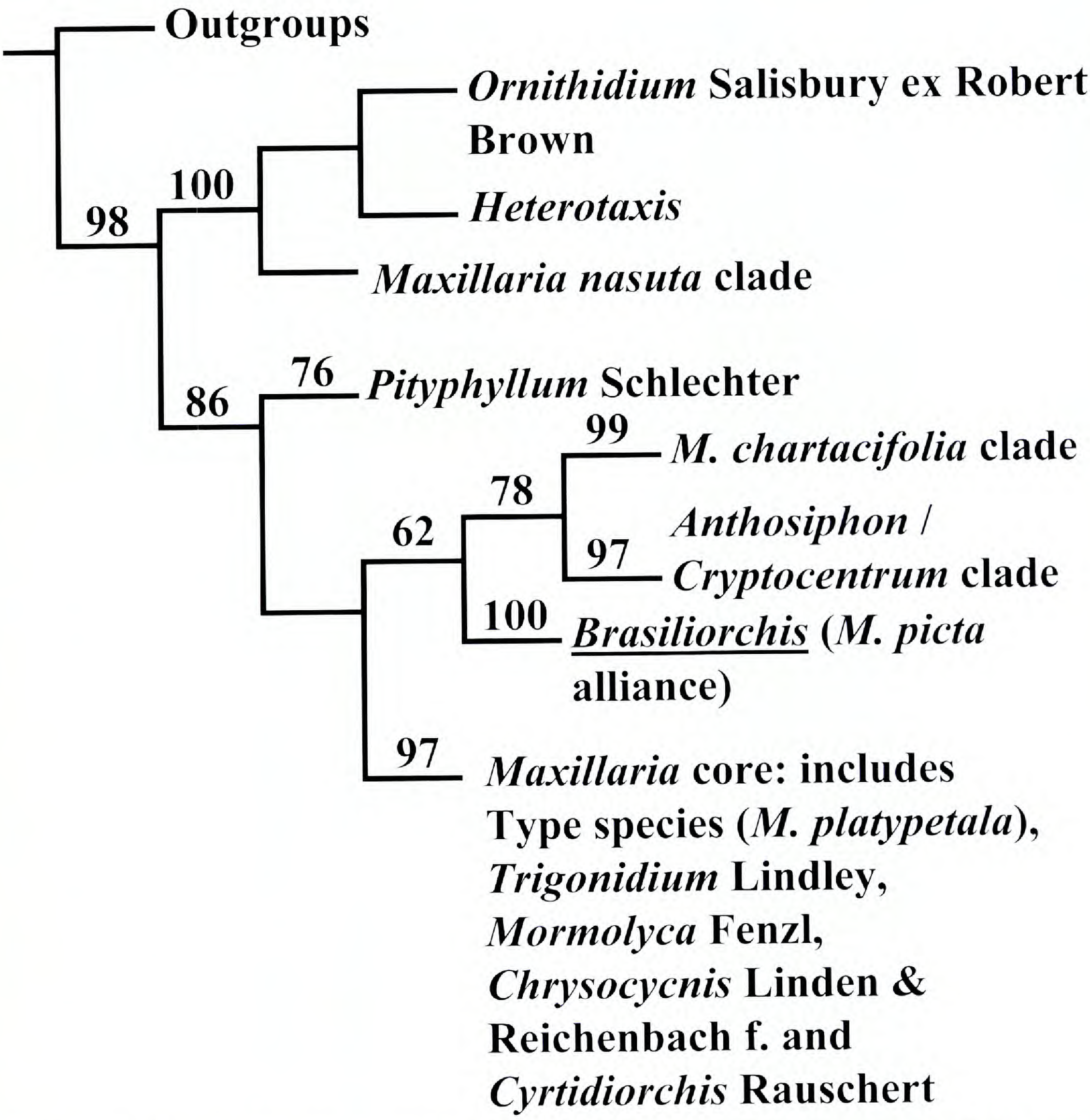

Figure 1. Broad generic relationships in orchid subtribe Maxillariinae. Simplified version of the molecular (ITS 1–2, *mat-K*, *atpB-rbcL* spacer, $n = 320$ taxa) cladogram. Bootstrap values of strongly supported clades are indicated above the branches (Whitten et al., unpublished data). Species of the genera *Bifrenaria* Lindley, *Lycaste* Lindley, and *Eriopsis* Lindley were used as outgroups.

siphon clade) is supported only by moderate to weak bootstrap values (bootstrap = 62%, Fig. 1), thus precluding the merging of all entities into a single genus. These clades are geographically isolated, as well as ecologically and morphologically different. Therefore, the recognition of the *M. picta* alliance as a distinct genus within the subtribe Maxillariinae appears supported by multiple sequence data and a combination of distinctive vegetative and floral features.

Barbosa Rodrigues (1877, 1882) described a total of eight species within this complex (under the genus *Maxillaria*): *M. chrysantha* Barbosa Rodrigues, *M. heismanniana* Barbosa Rodrigues, *M. lilacea* Barbosa Rodrigues, *M. phoenicanthera* Barbosa Rodrigues, *M. polyantha* Barbosa Rodrigues, *M. rupestris* Barbosa Rodrigues, *M. queirogana* Barbosa Rodrigues, and *M. serotina* Regnell & Barbosa Rodrigues. Four species have already been synonymized: *M. queirogana* and *M. lilacea* have been placed in synonymy with *M. gracilis* Loddiges (Cogniaux, 1904; Sprunger et al., 1996), *M. serotina* has been placed in synonymy with *M. chrysantha* (Cogniaux, 1904; Sprunger et al., 1996), and *M. rupestris* has been placed in synonymy with *M. picta* Hooker (Cogniaux, 1904; Sprunger et al., 1996). We herein accept and follow the aforementioned synonymizations.

Although Barbosa Rodrigues (1877, 1882) validly published the above species, these taxa pose some remarkable problems: (1) type localities are always specified, but no specific type specimens are identified, nor is their repository indicated; (2) these type specimens were possibly deposited at RB (Barbosa Rodrigues was its first curator), but they are clearly lost (see Sprunger et al., 1996); and (3) even when Barbosa Rodrigues (1877, 1882) indicated illustration numbers for each new taxon he described, his actual illustrations remain unpublished to date. It is clear that Barbosa Rodrigues (1877, 1882) intended to publish a complete iconography for his new taxa, without success. The tortuous history of Barbosa Rodrigues' new species is explained in Sprunger et al. (1996), but some details remain obscure. Authors have failed to find any type or potential type candidates (isotypes, paratypes) at RB. In addition, no type candidates have been found at SP.

Cogniaux (1904), with the agreement of Barbosa Rodrigues, published ink drawings based on Barbosa Rodrigues' original artwork. These drawings (Cogniaux, 1904) are the first published illustrations for these taxa. Therefore, in the absence of type specimens, the illustrations published by Cogniaux (1904) are the first choice for lectotypification. More recently, Sprunger et al. (1996) published a volume with copies of Barbosa Rodrigues watercolors made at Kew by Harriet Thiselton Dyer, during 1894–1895. Although these later copies (Sprunger et al., 1996) are colored, the drawings published by Cogniaux (1904) are, in our opinion, equally illustrative. In addition, the work of Cogniaux (1904), as the whole *Flora Brasiliensis*, is now freely available on the Internet (http://florabrasiliensis.cria.org.br/opus).

A similarly complex situation is posed by *Maxillaria barbozae* Loefgren. Loefgren (1918) based this species on "plants collected by Campos Porto, in 1908 and 1915, in Itatiaya," without indicating either a type specimen or its repository, although they were possibly deposited at RB. The authors have failed to find these specimens at RB. Because these collections are likely lost and no other type candidates have been found, the original illustration is herein designated as lectotype.

A more complex case is posed by *Maxillaria consanguinea* Klotzsch. This species was described (Klotzsh, 1853) without any indications of type specimens, their putative repository, or collector and almost without data regarding type locality. The putative type specimen or specimens may have been deposited at B, but they are positively lost. Therefore, lacking type specimens or an original illustration that could be designated as lectotype, the designation of a neotype for this taxon seems appropriate.

Brasiliorchis R. Singer, S. Koehler & Carnevali, gen. nov. TYPE: *Brasiliorchis picta* (Hooker) R. Singer, S. Koehler & Carnevali [= *Maxillaria picta* Hooker, Bot. Mag. 59: t. 3154. 1832].

Plantae epiphyticae vel rupicolae, pseudobulbis semper bifoliatis, sulcatis, aggregatis vel separatis. Radices laeves, ferrugineae, brunneae vel albae. Flores fragrantes, campanulati, sine secretionibus. Pollinarium plerumque sine tegula, cum viscidio semilunari, collapsanti. Plerumque plantae sylvicolae ubi in sylvis Brasiliae et Argentinae.

Brasiliorchis is a small (13 species), primarily Brazilian, orchid genus. In Brazil, the distribution of all species overlaps with the Atlantic Rain Forest Biome or Mata Atlântica (Hoehne, 1953; Pabst & Dungs, 1977), from Rio Grande do Sul (Waechter, 1998) to Bahia (Toscano de Brito & Cribb, 2005). Only three species extend their ranges beyond Brazil: *B. picta* (Hooker) R. Singer, S. Koehler & Carnevali and *B. chrysantha* (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali reach extreme northeastern Argentina, in Misiones (Correa, 1996; Johnson, 2001), and *B. marginata* (Lindley) R. Singer, S. Koehler & Carnevali has been reported in Ecuador (Toscano de Brito & Cribb, 2005). Two species (*B. kautskyi* (Pabst) R. Singer, S. Koehler & Carnevali and *B. schunkeana* (Campacci & Kautsky) R. Singer, S. Koehler & Carnevali) are endemic to the Brazilian state of Espírito Santo (Singer & Koehler, 2004). The genus can be identified easily in the field through a set of consistent morphological features. The pseudobulbs are always bifoliate and ridged to sulcate (Fig. 2A). The leaves are conduplicate and strap-like, longer in individuals growing in shady places and stiffer, shorter, and yellowish green in plants growing in sunnier conditions. As an exception, *B. kautskyi* displays acicular leaves. The roots are smooth and reddish or brownish to white in color. The flowers are campanulate (Fig. 2B, C), showy and long-lasting (10 days or more), fragrant, and devoid of secretions or pluricellular trichomes. The floral pedicel is normally well developed. The column is almost straight and lacks lateral appendages (column wings) (Fig. 2D), while the column foot is not as well developed as in other members of the Maxillariinae. The anther is incumbent and umbonate, holding a pollinarium made up by two subequal pairs of dorsally compressed, yolk-yellow pollinia (Fig. 2F). In most species, the pollinarium lacks tegular stipe and displays a soft, hyaline, semilunar viscidium that readily collapses after pollinarium removal (Singer & Koehler, 2003, 2004). Most species present tightly aggregated pseudobulbs. In a few species (*B. marginata*, *B. chrysantha*), the pseudobulbs are separated by a conspicuous rhizome that is covered by dry bracts. The flowers of most

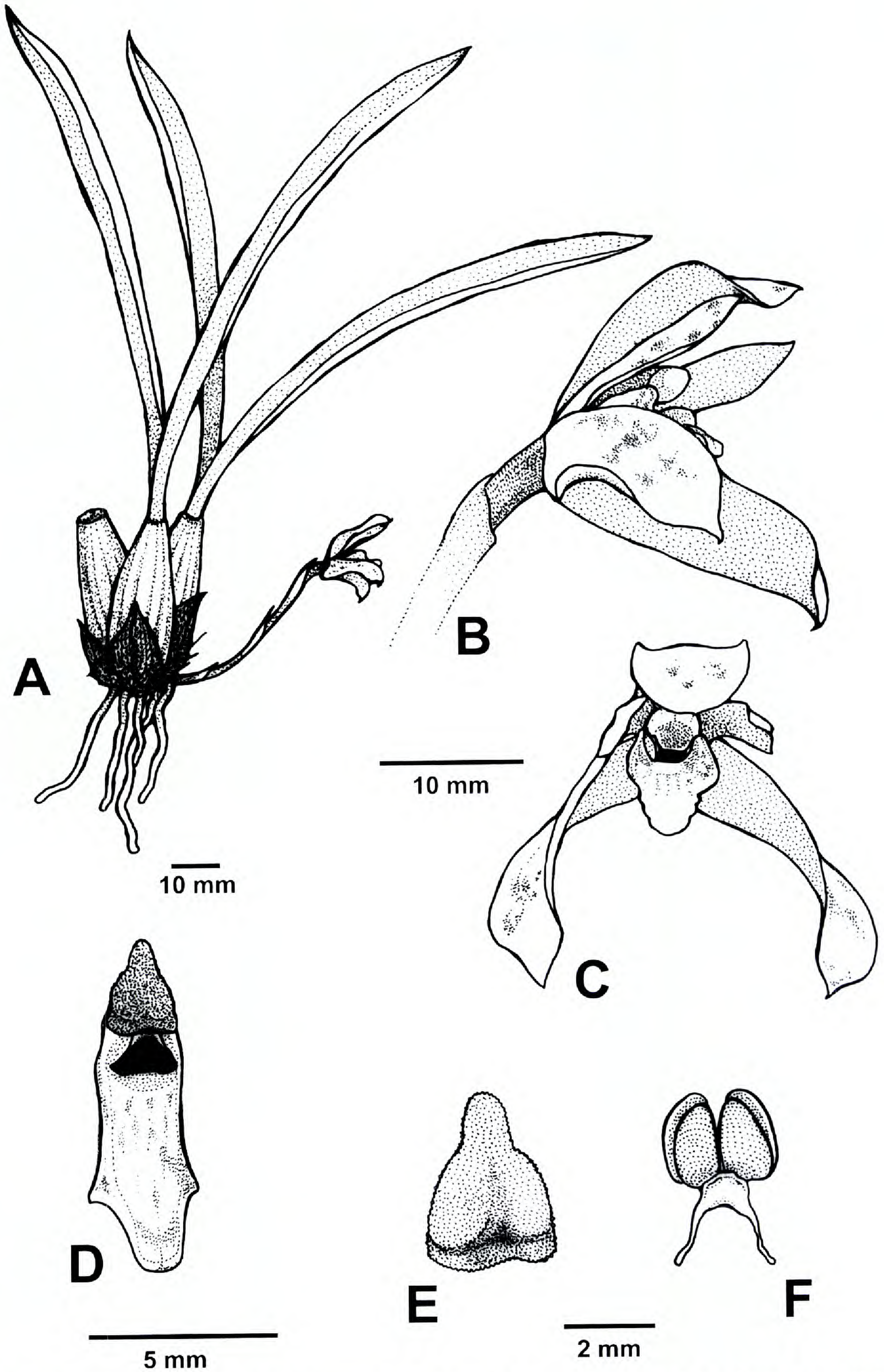

Figure 2. *Brasiliorchis picta* (Hooker) R. Singer, S. Koehler & Carnevali. —A. Habit. Notice the bifoliate, conic pseudobulbs. —B, C. Flower. B. Lateral view. C. Frontal view. —D. Column. —E. Anther cap. —F. Pollinarium. Based on: Pedra Grande, Atibaia, São Paulo, 11 Aug. 2003, *R. B. Singer, R. Farias-Singer & S. Gomes s.n.* (ICN 144787).

species combine cream or yellowish cream colorations with purple dots or maculation. The flowers of the small-sized *B. barbozae* (Loefgren) R. Singer, S. Koehler & Carnevali and *B. schunkeana* are exceptional within the genus in displaying a dark, shining labellum, similar to those of the *Maxillaria* species belonging to the *M. madida* Lindley alliance (Pabst & Dungs, 1977) or to the species related to *M. nasuta*

Reichenbach f. The few chromosome counts available for the group (of *B. picta*) are of $2n = 40$ (Blumenschein, 1960; Carnevali, 1991).

Etymology. From "Brasilia" (Brazil) and "orchis" (orchid, Orchidaceae). The name emphasizes that this is essentially a Brazilian orchid genus.

New Combinations

1. Brasiliorchis barbozae (Loefgren) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria barbozae* Loefgren, Arch. Jard. Bot. Rio de Janeiro 2: 60. 1918. TYPE: Brazil. Rio de Janeiro: Itatiaya (lectotype, designated here, tab. XXV, in Loefgren, 1918). EPITYPE: Brazil. Rio de Janeiro: Itatiaia, Maromba, 22 May 1935, *A. C. Brade 14630* (epitype, designated here, RB).

Loefgren (1918) based his new species on specimens prepared from "plants collected by Campos Porto, in 1908 and 1915, in Itatiaya," without indicating a type collection or its repository, although they were possibly deposited at RB. These collections are likely lost, and the original illustration is herein designated as lectotype. Because the original illustration is a bit schematic regarding pseudobulb and flower features, we propose an epitype (*A. C. Brade 14630*, RB), which comes from the type locality and, in our opinion, is fully representative of this species.

2. Brasiliorchis chrysantha (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria chrysantha* Barbosa Rodrigues, Gen. Sp. Orchid. 1: 115. 1877. TYPE: Brazil. Sapucahy (lectotype, designated here, tab. 5 in Cogniaux, 1904: 46–47).

Barbosa Rodrigues (1877) validly published *Maxillaria chrysantha*, but his illustration for this taxon remained unpublished until Cogniaux (1904) published an ink drawing based on Barbosa Rodrigues' original artwork. This plate constitutes the first published illustration of this species, and we herein designate it as lectotype because no extant type specimens are known to the authors.

3. Brasiliorchis consanguinea (Klotzsch) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria consanguinea* Klotzsch, Ann. Sci. Nat., Bot. sér. III, 19: 376. 1853. TYPE: Brazil. Rio de Janeiro: Nova Friburgo, Morro da Caledonia, 7 Mar. 1937, *E. Amarante s.n.* (neotype, designated here, RB).

Maxillaria consanguinea Klotzsch. var. *major* Hoehne, Arq. Bot. Estado São Paulo, n.s. 2(6): 128. 1952. Syn. nov. TYPE: Brazil. sine loc., 14 June 1930, *F. C. Hoehne s.n.* (holotype, SP) [cultivated at the Jardim Botânico, São Paulo].

Maxillaria consanguinea Klotzsch. f. *pallida* Hoehne, Icon. Orchid. Bras., tab. 229. 1949. Syn. nov. TYPE: Brazil, São Paulo, Ipanema, 27 Dec. 1932, *F. C. Hoehne s.n.* (holotype, SP).

Maxillaria piresiana Hoehne, Arq. Bot. Estado São Paulo, n.s. 2(6): 128. 1952. Syn. nov. TYPE: Brazil. São Paulo, 1898, *G. Edwall CGG 3879* (lectotype, designated here, SP).

The type collection and any other possible type candidates for *Brasiliorchis consanguinea* are apparently lost. In addition, the original description lacks an illustration that could be designated as lectotype. Therefore, we herein propose a neotype for *B. consanguinea* that, in our opinion, is fully representative of this taxon. Hoehne (1953: 285) examined this specimen for his *Flora Brasilica* and indicated its similarity with the type description. This specimen is complete regarding flower and vegetative features.

During the examination of the syntypes of *Maxillaria piresiana* (*A. Gehrt s.n.*, SP; *F. C. Hoehne & M. Kuhlmann s.n.*, SP; *G. Edwall CCG 3879*, SP), we concluded that they only represent continuous phenotypical variations of *Brasiliorchis consanguinea*. The affinity between these two taxa was already noticed by Hoehne (1953). Given the great morphological resemblance between these taxa, we place *M. piresiana* in synonymy with *B. consanguinea*. The specimen *G. Edwall 3879* (SP) seems complete and fully representative of this taxon and is herein designed as lectotype.

4. Brasiliorchis gracilis (Loddiges) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria gracilis* Loddiges, Bot. Cab. 19: tab. 1837. 1832. TYPE: [Brazil.] sine loc., sine coll. (holotype, K).

5. Brasiliorchis heismanniana (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria heismanniana* Barbosa Rodrigues, Gen. Sp. Orchid. 2: 201. 1882. TYPE: Brazil. Rio de Janeiro: Rodeio (lectotype, designated here, tab. 8(II) in Cogniaux, 1904: 38–39).

Barbosa Rodrigues (1882) validly published *Maxillaria heismanniana*, but his illustration for this taxon remained unpublished until Cogniaux (1904) published an ink drawing based on Barbosa Rodrigues' original artwork. This plate constitutes the first published illustration of this species, and we therefore designate it as lectotype because no extant type specimens are known to the authors.

6. **Brasiliorchis kautskyi** (Pabst) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria kautskyi* Pabst, Bradea 1(20): 181. 1972. TYPE: Brazil. Espírito Santo: prox. Domingos Martins, 25 July 1965, *R. Kautsky 100* (holotype, HB; isotype, K).
7. **Brasiliorchis marginata** (Lindley) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Cymbidium marginatum* Lindley, Bot. Reg. 18: tab. 1530. 1833. *Maxillaria marginata* (Lindley) Fenzl, Fl. des Serres, ser. 1(10): 112. 1854 [1855]. TYPE: Brazil. Rio de Janeiro, s.d., s. coll. (holotype, K).

Maxillaria murilliana Hoehne, Arq. Bot. Estado São Paulo, n.s. 2: 130. 1952. Syn. nov. TYPE: Brazil. São Paulo: Sorocaba, s.d., *O. Derby CGG 6053* (holotype, SP).

The analysis of the holotype of *Maxillaria murilliana* deposited at SP convinced us that this taxon only represents a morphological variation of *Brasiliorchis marginata*. The similarity between these taxa was already noticed by Hoehne (1953). Therefore, we place this taxon under the synonymy of *B. marginata*.

8. **Brasiliorchis phoenicanthera** (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria phoenicanthera* Barbosa Rodrigues, Gen. Sp. Orchid. 2: 200, tab. 659. 1882. TYPE: Brazil. Rio de Janeiro: Rodeio (lectotype, designated here, tab. 9(III) in Cogniaux, 1904: 45).

Barbosa Rodrigues (1882) validly published *Maxillaria phoenicanthera*, but his illustration for this taxon remained unpublished until Cogniaux (1904) published an ink drawing based on Barbosa Rodrigues' original artwork. This plate constitutes the first published illustration of this species, and we therefore designate it as lectotype because no extant type specimens are known to the authors.

9. **Brasiliorchis picta** (Hooker) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria picta* Hooker, Bot. Mag. 59: tab. 3154. 1832. TYPE: Brazil. Rio de Janeiro: Organ Mtns. (lectotype, designated here, tab. 3154 in Hooker, 1832).

This plate is based on a plant sent to England from the Organ Mountains, in the state of Rio de Janeiro, Brazil. There is no type specimen deposited at K; therefore, we herein designate the original illustration as the lectotype.

10. **Brasiliorchis polyantha** (Barbosa Rodrigues) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria polyantha* Barbosa Rodrigues, Gen. Sp. Orchid. 2: 202. 1882. TYPE: Brazil. Rio de Janeiro: Serra do Mar (lectotype, designated here, tab. 9(II) in Cogniaux, 1904: 37–38).

Barbosa Rodrigues (1882) validly published *Maxillaria polyantha*, but his illustration for this taxon remained unpublished until Cogniaux (1904) published an ink drawing based on Barbosa Rodrigues' original artwork. This plate constitutes the first published illustration for this species, and we therefore designate it as lectotype because extant type specimens are unknown to the authors.

11. **Brasiliorchis porphyrostele** (Reichenbach f.) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria porphyrostele* Reichenbach f., Gard. Chron. 1: 978. 1873. TYPE: Brazil. Rio Grande do Sul, [Feb. 1873], *Mr. Bull s.n* (holotype, K).
12. **Brasiliorchis schunkeana** (Campacci & Kautsky) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria schunkeana* Campacci & Kautsky, Orquidário 7(4): 136. 1993. TYPE: Brazil. Santa Leopoldina, Espirito Santo, Sept. 1990, *V. Schunk s.n.* (holotype, SP).
13. **Brasiliorchis ubatubana** (Hoehne) R. Singer, S. Koehler & Carnevali, comb. nov. Basionym: *Maxillaria ubatubana* Hoehne, Arq. Bot. Estado São Paulo n.s. 2(4): 88. 1947. TYPE: Brazil. São Paulo: Alto da Serra de Ubatuba, May 1946, *F. C. Hoehne s.n.* (holotype, SP).

Separating *Brasiliorchis* from Other Sympatric Bifoliate Maxillariinae Orchids

A number of Brazilian Maxillariinae orchids sympatric with *Brasiliorchis* also present bifoliate pseudobulbs. When these taxa are in bloom, identification is unequivocal, but as can be seen in the following artificial key, all these orchids groups can be set apart mostly through the use of vegetative characters.

Artificial Key to Separate *Brasiliorchis* from Other Sympatric, Bifoliate Brazilian Maxillariinae Orchids

1a. Leaves conduplicate or acicular, flowers solitary . . . 2
1b. Leaves plicate, inflorescences pluriflorous . . . . . *Xylobium squalens* (Lindley) Lindley and related taxa
2a. Roots smooth, variously coloured. 3
2b. Roots with ring-like constrictions, whitish . . . . . *Maxillaria madida* Lindley and related taxa (some forms)
3a. Pseudobulbs ridged or sulcate, conic, rhizome between pseudobulbs short or conspicuous . . . . . *Brasiliorchis*
3b. Pseudobulbs smooth, laterally flattened, elliptic, roundish or conic 4

4a. Pseudobulbs aggregated 5
4b. Pseudobulbs separated by a conspicuous rhizome, covered by bracts 6
5a. Pseudobulbs roundish to elliptic, flowers erect, trigonous . . . . . *Trigonidium obtusum* Lindley and related taxa
5b. Pseudobulbs conic or claviform, flowers campanulate, with resin-like secretions at labellum surface . . . . . *Maxillaria scorpioidea* Kraenzlin (Obs.: there are, in addition, trifoliate plants or pseudobulbs)
6a. Pseudobulbs small, up to 2 cm in length, bracts covering the rhizome normally dry and brown. Flowers with long pedicels, with whitish wax-like secretion at labellum surface . . . . . *Maxillaria cerifera* Barbosa Rodrigues and related taxa
6b. Pseudobulbs bigger than 2 cm in length. Flowers with short pedicels 7
7a. Bracts covering the rhizome normally alive and green. Flowers with a tuft of clavate trichomes at labellum surface . . . *Maxillaria camaridii* Reichenbach f.
7b. Bracts covering the rhizome normally dry and brown. Flowers with a glabrous, shiny labellum. . . . . *Maxillaria johannis* Pabst

Natural History

Brasiliorchis plants are quite tolerant regarding light and soil conditions, a fact that renders them phenotypically variable. Plants may either occur as epiphytes or lithophytes. Plants in shady habitats tend to develop longer, broader and darker leaves. Conversely, plants in sunnier places tend to develop smaller, yellowish leaves. The flowers of most species are fragrant (Flach et al., 2003) and devoid of any reward to the pollinators (Singer & Cocucci, 1999; Singer & Koehler, 2003, 2004; Singer, 2003). Meliponini bees of the genus *Trigona* and some wasps of the Vespidae family have been recorded as pollinators (Singer & Cocucci, 1999; Singer & Koehler, 2004; Singer, 2003). Because the flowers are rewardless, floral visits are likely restricted to the very first days after blooming. With the exception of *B. chrysantha*, all *Brasiliorchis* species whose breeding system could be studied have been shown to be strongly self-incompatible (self-pollinated flowers abort) (Singer, unpublished). Some species, such as *B. picta*, *B. porphyrostele*, and *B. chrysantha*, are widely cultivated and have ornamental, long-lasting flowers. To date, there are no clear indications that any species within the genus are at risk of extinction. Perhaps this could be the case for *B. schunkeana* and *B. kautskyi*, two small species endemic to Espírito Santo, a Brazilian State that has almost eradicated its forests. However, conclusive evidence is lacking.

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Festuca renvoizei and *F. urubambana* (Poaceae, Loliinae), Two New Species from Peru

Daniel Stančík

Department of Botany, Faculty of Science, Charles University, Benátská 2, 128 01 Prague, Czech Republic. dan_stancik@yahoo.com

Abstract. Two new species, *Festuca renvoizei* Stančík and *F. urubambana* Stančík (Poaceae, Loliinae), from the Peruvian Andes are described. *Festuca renvoizei* (subg. *Festuca* L. sect. *Festuca* L.) comes from the páramo (jalca) zone of northern Peru, while *F. urubambana* (subg. *Erosiflorae* E. B. Alexeev) grows in humid mountain forests in southern Peru (Cuzco region). Both species are endemic to Peru. Data for evaluation of IUCN conservation status are deficient, but both species seem to be rare and probably vulnerable.

Resumen. Se presentan dos especies nuevas, *Festuca renvoizei* Stančík y *F. urubambana* Stančík (Poaceae, Loliinae), endémicas de los Andes del Perú. La especie *F. renvoizei* pertenece al subgénero *Festuca* L. sect. *Festuca* L. y se conoce de la zona paramúna (jalca) del norte del Perú. La especie *F. urubambana* es un representante del subgénero *Erosiflorae* E. B. Alexeev, endémica de los valles de la zona del bosque húmedo altoandino de la región de Cuzco. No hay datos suficientes para la evaluación del estado de conservación y vulnerabilidad de la UICN. Sin embargo parece que se trata de especies raras y probablemente vulnerables.

Key words: Andes, *Festuca*, Loliinae, Peru, Poaceae.

In South America, the genus *Festuca* L. is represented by more than 140 species (Darbyshire et al., 2003). This is about 30% of the world diversity of this cosmopolitan genus. The Andean zone of Peru and Bolivia, where about 57 species (Brako & Zarucchi, 1993; Renvoize, 1998) are reported, is a region of major species concentration in South America. Of the 49 species recorded in Peru, 32 are endemic to this region (Stančík, in prep.).

The first descriptions of Peruvian *Festuca* come from J. Presl (1830–1831) and were based on Haenke's collections made during his Malaspine expedition in 1789–1794. Other historic Peruvian specimens can be found in herbaria around the world (B, K, P, US, W; D. Stančík, pers. obs.); they come from the collections of Capt. Wilkes (*Wilkes 5* (K), *Wilkes s.n.* (US), collected in the period 1838–1842), W. Lechler (*W. Lechler 899* (B), *W. Lechler 1826* (K), *W. Lechler 1829* (P, W), *W. Lechler 2114* (P, W), collected in 1852–1856), C. Jelski (*C. Jelski 421* (W), collected in 1879), and J. Ball (*J. Ball 262* (K), *J. Ball s.n.* (K), collected in 1882). Ball (1885) also published descriptions of several new species. The first monographer of the grasses of Ecuador, Peru, and Bolivia was A. Hitchcock (1927), who mentioned just 17 species of *Festuca*, with 11 of those species present in Peru. Later Standley (1936) in the *Flora of Peru* published 12 species. The most recent monographs of *Festuca* in Peru are by O. Tovar (1972, 1993); these described several new species and increased the total to 37 species. Finally, Brako and Zarucchi (1993) listed 42 species. Despite the relatively high attention paid to this genus in studies on the flora of Peru, the status of some of the species still remains unclear, and the knowledge of the genus is still incomplete. Two Peruvian species, which are new to science, are described herein as a result of the detailed study of ca. 4500 specimens of South American *Festuca* deposited in many herbaria (AAU, B, BM, C, COL, CONC, F, K, LPB, MO, NY, P, PR, PRC, QCNE, SGO, U, US, W, etc.). Both species descriptions are based on specimens from these herbarium collections; observation of these specimens reveals that they are endemic to the Peruvian Andes. *Festuca renvoizei* Stančík belongs in subgenus *Festuca* sect. *Festuca* L.: this is the dominant section of *Festuca* in South America and includes about 80% of all species. *Festuca urubambana* Stančík belongs in subgenus *Erosiflorae* E. B. Alexeev, which is restricted to South America. Until now seven species from the mountain forest zones of Argentina, Bolivia, Colombia, Ecuador, Peru, and Venezuela were attributed to this subgenus.

Festuca renvoizei Stančík, sp. nov. TYPE: Peru. Cajamarca: Las Lagunas, 50 km from Cajamarca on rd. to Bambamarca, in very wet area beside lagoon, 4000 m, 29 Mar. 1988, *S. Renvoize & S. Laegaard 5031* (holotype, K; isotypes, AAU, CPUN). Figure 1.

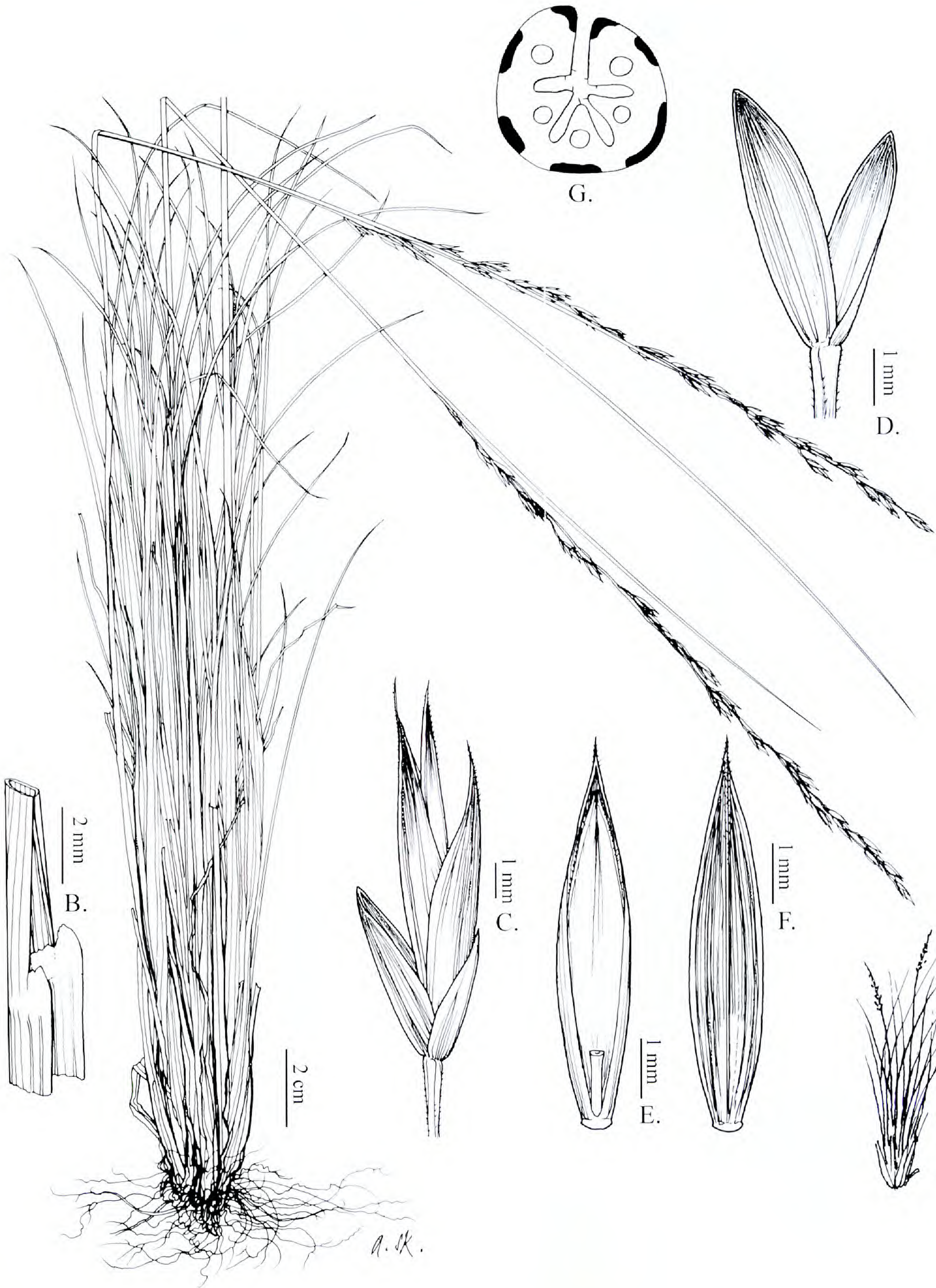

Figure 1. *Festuca renvoizei* Stančík. —A. Habit. —B. Ligule. —C. Spikelet. —D. Glumes. —E. Lemma with palea and rachilla. —F. Lemma. —G. Leaf blade cross section. Drawn from the holotype, *Renvoize & Laegaard 5031* (K).

Haec species a *Festuca carchiensi* Stančík et *F. imbaburensi* Stančík ligula foliari 1.2–1.5 (non 0.5–0.8) mm, foliis glabris (non scabratis), rachilla glabrata (non pilosa) differt; a *F. glumosa* Hackel ex E. B. Alexeev, foliis tenuioribus (0.5–0.7 non 0.8–1.4 mm diam.), glumis minoribus (inferioribus 3.5–4.5 non 4.5–6 mm, superioribus 5–5.5 non usque ad 6.5 mm), panicula majore (11–17 non 8–10 cm) differt.

Perennial small *tussocks* 40–50 cm tall; innovations intravaginal; *culms* erect, scabrous, with 1 basal node. *Sheaths* membranous, brownish gray, glabrous, margins free; *auricles* absent; *ligules* membranous, shortly ciliate, 1.2–1.5 mm; *leaf blade* linear, involute, obtuse, ca. 20–30 × 0.5–0.7 mm diam., glabrous,

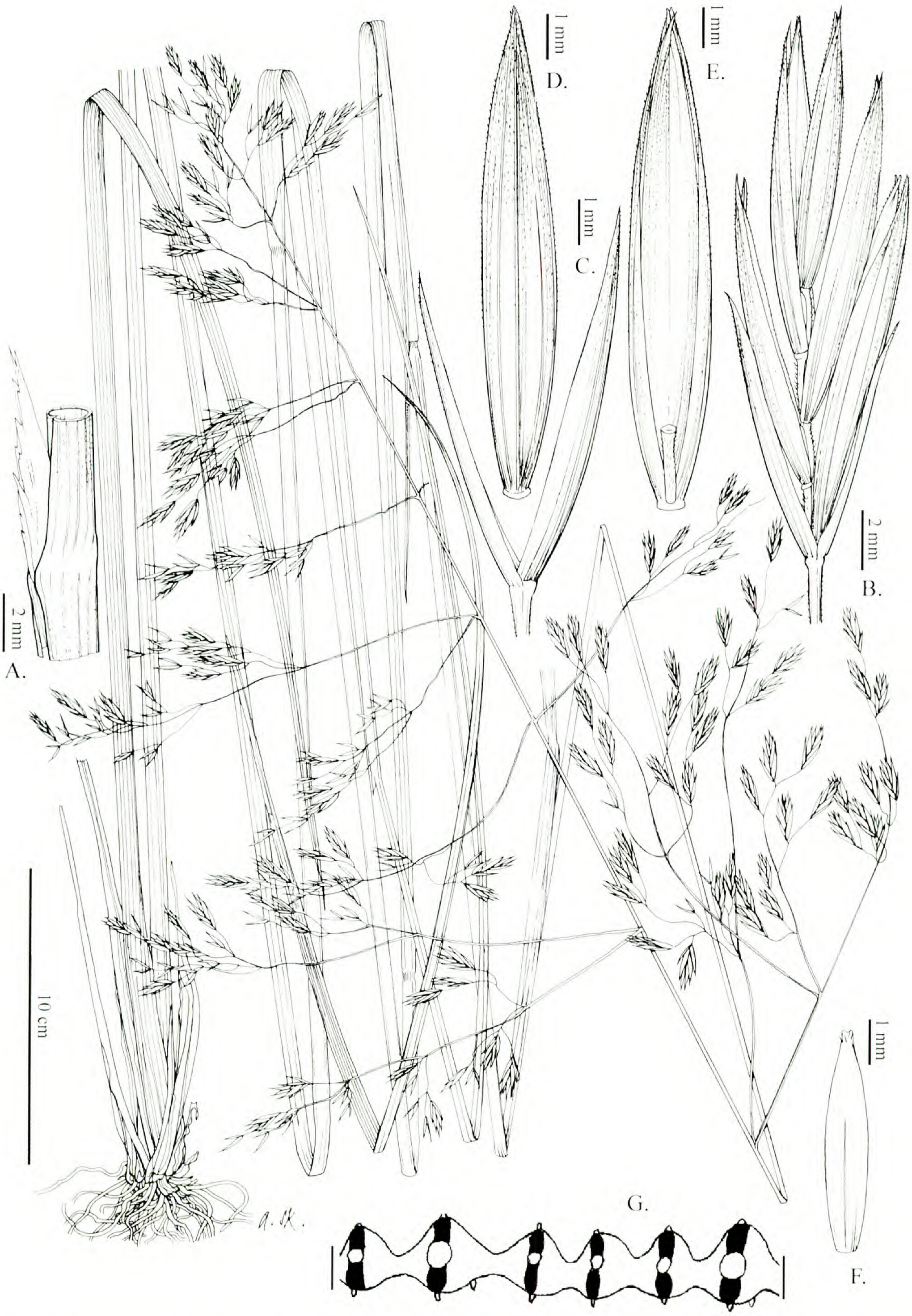

Figure 2. *Festuca urubambana* Stančík. —A. Ligule. —B. Spikelet. —C. Glumes. —D. Lemma. —E. Lemma with palea and rachilla. —F. Caryopsis (sparsely pubescent at apex). —G. Leaf blade cross section. Drawn from the holotype, *Iltis et al. 853* (K).

green. *Panicle* contracted, slender, 11–17 × 0.5–0.7 cm; branches scabrid on all surfaces. *Spikelet* 9–10.5 mm, lanceolate, with 2 to 3 perfect florets; *rachilla* glabrate; *glumes* membranous, dark purple, almost glabrous; lower glumes 3.5–4.5 mm, lanceolate, acute, 1-nerved; upper glumes 5–5.5 mm, oblong-lanceolate, acute, 3-nerved; *lemmas* 7–7.5 mm, 5-nerved, membranous, lanceolate, dark

purple, rough in upper part; *awn* 0.5–1 mm; *callus* glabrous; *palea* membranous, 2-keeled, upper 1/3 and along keels pubescent, markedly bidentate, 4/5 of total; *lodicules* lanceolate, ca. 0.8 mm; *stamens* 3, *anthers* 1–1.2 mm; ovary apex glabrous. Caryopses not observed. *Leaf blade cross section* with 5 to 8 vascular bundles, 5 opposite adaxial ribs; sclerenchyma under abaxial epidermis discontinuous and small, adaxial sclerenchyma absent; trichomes 0.1 mm, scattered on adaxial epidermis.

Observations. This species belongs in the *Festuca glumosa* group of small bunch grasses with dense contracted panicles of lanceolate spikelets. This group is restricted to the grass-páramo vegetation of Ecuador and Colombia and includes *F. glumosa*, *F. imbaburensis*, *F. carchiensis*, *F. boyacensis* Stančík, *F. cocuyana* Stančík, and *F. sanctae-martae* Stančík.

Distribution and habitat. Festuca renvoizei is known only from the Department of Cajamarca in northern Peru. Here it grows in jalca, the southernmost grass-páramo formation, at 3900–4000 m.

Etymology. The epithet is given to honor the British agrostologist and explorer of South American grasses, Steve Renvoize.

Paratype. PERU. **Cajamarca:** Parte baja del Cerro Shillas Negras y Laguna Totora, 3920 m, 23 Apr. 1994, *I. Sánchez V. 7011* (CPUN, F).

Festuca urubambana Stančík, sp. nov. TYPE: Peru. Cuzco: Urubamba, a deep side valley of Río Urubamba, ca. 2–4 km NW of Urubamba, 31 Dec. 1962, *H. H. Iltis et al. 853* (holotype, K). Figure 2.

Haec species a *Festuca quadridentata* Kunth glumis majoribus (inferioribus 5–7(–8.5) non 3.5–5 mm, superioribus 6.5–9.5 non 5–6.5 mm) differt; a *F. quadridentata* et *F. dichoclada* Pilger apice ovarii ciliato non glabro differt.

Large perennial *tussocks*, to 250 cm tall; innovations intravaginal; *culms* erect, glabrous, with 2 to 4 nodes in distal half. *Sheaths* coriaceous, striate, glabrous; *auricles* absent; *ligules* membranous, acute, 4–10(–12) mm; *leaf blade* flat (or partly involute), 50–100 × 0.4–0.8 cm, green, scabrous, with prickles on the abaxial and adaxial epidermis. *Panicle* ovate, 30–40 × 30 cm; branches scabrous. *Spikelets* 11–16 mm, oblong, with (3)4 to 6 florets; *rachilla* with long hairs; *glumes* lanceolate, acute, greenish white, scabrous; lower glumes 5–7(–8.5) mm, 1-nerved; upper glumes 6.5–9.5 mm, 3-nerved; *lemma* lanceolate, 8.5–11 mm, 5-nerved, coriaceous, scabrous, apex entire, awnless or shortly mucronate (0–0.7 mm); *callus* glabrous, exceptionally with scattered trichomes; *palea* as long as lemma, scabrous, 2-keeled; *lodicules* lanceolate, ca. 0.8 mm; *stamens* 3, anthers (3–)4–5.5 mm, *ovary apex* sparsely pubescent. Caryopsis lanceolate; hilum linear, 3/5 of total length.

Observations. This new *Festuca* belongs in subgenus *Erosiflorae*, which is characterized by large tussocks, flat leaves with cataphylls, long ligules (5–15 mm), and opened, ramified panicles of large spikelets. This subgenus is restricted to mountain forests of South America and also includes *F. dichoclada* (Peru), *F. quadridentata* (Ecuador, Peru), *F. horridula* Pilger (Peru), *F. steinbachii* E. B. Alexeev (Bolivia), *F. superba* Parodi ex Turpe (Argentina), and *F. venezuelana* Stančík (Colombia, Venezuela).

Distribution and habitat. This species is endemic to the Cuzco region of southern Peru. It grows in the mountain forest zone, at altitudes from 3200–3800 m.

Etymology. The specific epithet refers to the type locality region—the Urubamba River Valley in southern Peru.

Paratypes. PERU. **Cuzco:** Urubamba "Cebadilla," *J. Soukup 38* (F); Urubamba, trail from Chincheros, playa to Antakillqa hillside, *E. W. Davis & E. Franquemont 1423* (F); Jucay, *J. Soukup 743* (F); Valle del Paucartambo, hac. Campana, *F. L. Herrera 1098* (F), *F. L. Herrera 883* (BM); Urubamba, above Urubamba, Chicon Valley below Nevado Chainapuerto, *J. Brandbyge 464* (AAU).

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A New Species of *Psychotria* subg. *Psychotria* (Rubiaceae, Psychotrieae) from West-Central Mexico

Charlotte M. Taylor
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299 U.S.A.
charlotte.taylor@mobot.org

Eduardo Domínguez-Licona and Helga Ochoterena
Instituto de Biología, Universidad Nacional Autónoma de México, Apdo. Postal 70-367, México D.F. 04510, México

Abstract. *Psychotria chamelaensis* C. M. Taylor & E. Domínguez-Licona was previously confused with *P. erythrocarpa* Schlechtendal, but this new species can be recognized by its longer narrow calyx lobes and moderate to dense, usually appressed pubescence. It is well documented by specimens from the Chamela Biological Station in Jalisco, Mexico, and is so far known only from at or near that site.

Resumen. *Psychotria chamelaensis* C. M. Taylor & E. Domínguez-Licona había sido confundida con *P. erythrocarpa* Schlechtendal, pero esta nueva especie puede ser reconocida por sus lóbulos del cáliz más largos y angostos y por la pubescencia moderada a densa y usualmente adpresa. La especie está bien respaldada con ejemplares de la Estación de Biología de Chamela (IBUNAM) en Jalisco, México y hasta ahora sólo se conoce de ese sitio y sus alrededores.

Key words: Mexico, *Psychotria*, Rubiaceae.

Psychotria L. (Psychotrieae) in its broad sense comprises approximately 1000 species of mostly shrubs and small trees found throughout the tropics. This genus is characterized by its usually woody habit; its relatively small, entomophilous, usually white or cream-colored flowers that are typically distylous; its valvate corolla lobe aestivation; its inferior ovary with usually two locules, each with one basal ovule; and its drupaceous fruits with usually two planoconvex pyrenes (Hamilton, 1989). As summarized by Taylor (2002), systematic studies using both morphological and molecular characters have indicated that Neotropical *Psychotria* as it is currently circumscribed is systematically complex (Taylor, 1996; Nepokroeff et al., 1999; Andersson & Rova, 1999; Piesschaert, 2001; Andersson, 2002). All of these studies have agreed, though, that *Psychotria* subg. *Psychotria* is supported as a generally monophyletic group.

Psychotria subg. *Psychotria* is a pantropical group characterized by the distinctive brown to gray or cinnamon color of its dried specimens; stipules of varied form that are nearly always caducous exposing a ring of well-developed infrastipular colleters (i.e., glandular trichomes) that usually persist on the stem (Fig. 1D); white corollas with tubes generally 1–8 mm long that are pubescent in the throat and/or at the point of stamen insertion; and orange to red fruits that bear two planoconvex, usually longitudinally ridged pyrenes. The pyrenes are characterized by an alcohol-soluble reddish pigment and a lack of preformed germination slits (Petit, 1964; Nepokroeff et al., 1999; Piesschaert, 2001). In Mexico *Psychotria* in its broad sense comprises two groups; the other group, *Psychotria* subg. *Heteropsychotria* Steyermark, is wholly Neotropical and can be distinguished from subgenus *Psychotria* by its dried specimens with a generally green color; its stipules also of various forms but nearly always persistent; its fruits that are white, blue, or purple at maturity; and its pyrenes lacking alcohol-soluble red pigments and bearing preformed germination slits.

The species we describe below was discovered during study of the Rubiaceae for the Flora of Chamela project. Specimens of this new species were previously included by Hamilton (1989) in *Psychotria erythrocarpa* Schlechtendal, a widespread and frequently collected species that is found in moist, often seasonal vegetation from central Mexico through Guatemala. *Psychotria erythrocarpa* and *P. chamelaensis* are quite similar in general aspect and share leaves of generally similar size and shape, calyptrate stipules of similar size that split along one side and become papery before falling off, inflorescences of similar size and arrangement, and corollas and fruits of similar size and shape. However, this new species differs from *P. erythrocarpa* in its strigillose or short-hirtellous pubescence of the leaves and stems (vs. pilosulous, hirtellous, or velutinous in *P. erythro-*

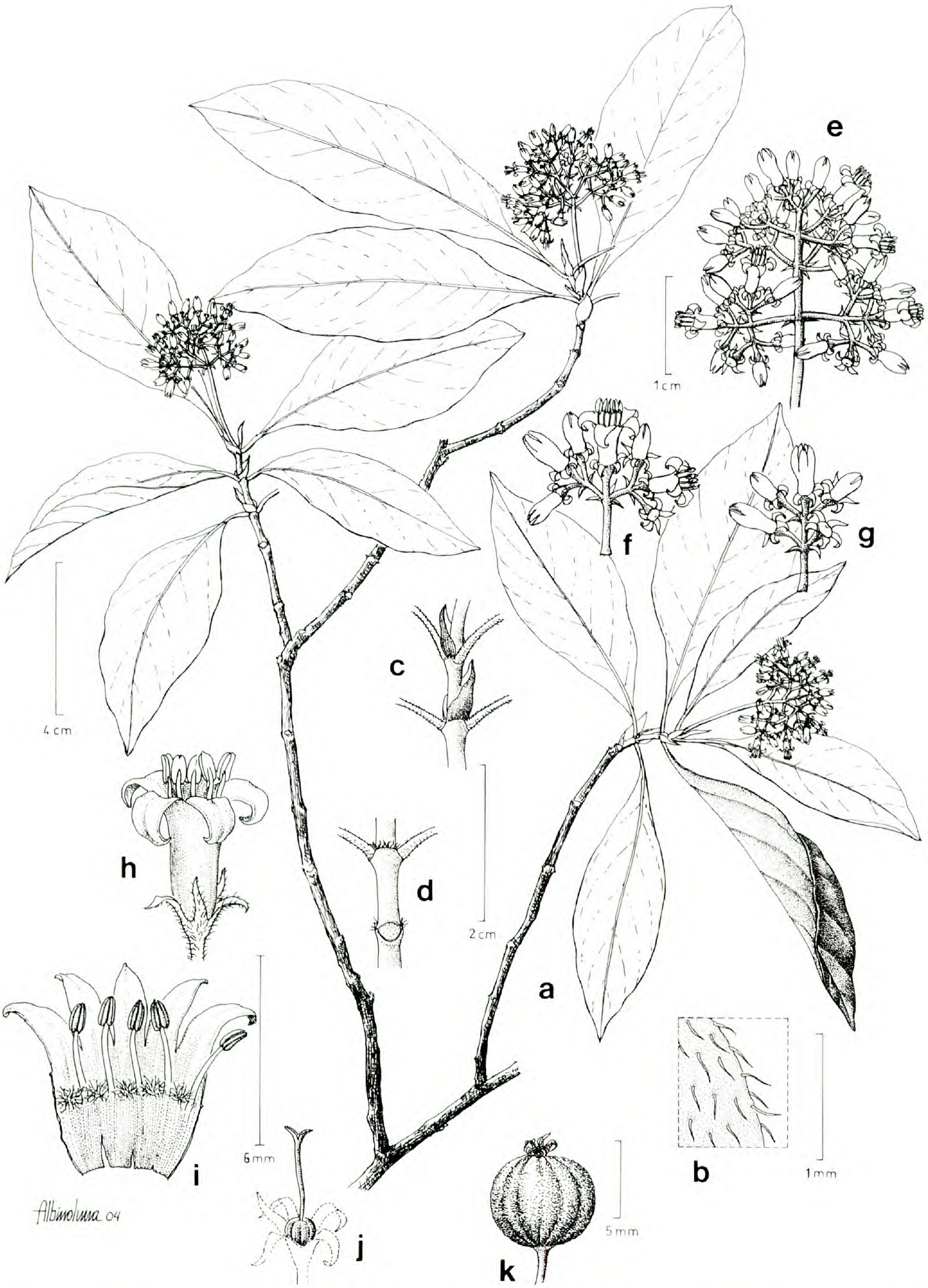


Figure 1. *Psychotria chamelaensis* C. M. Taylor & E. Domínguez-Licona. —a. Flowering branches. —b. Detail of leaf showing the adaxial pubescence. —c. Portion of stem showing old stipules. —d. Portion of stem from which stipules have fallen. —e. Inflorescence. —f. Portion of inflorescence with several flower buds, two short-styled flowers at anthesis, and one old flower from which the corolla has fallen. —g. Portion of inflorescence with several flowers in bud and one old flower from which the corolla has fallen. —h. Short-styled flower at anthesis. —i. Corolla of a short-styled flower at anthesis, partially dissected. —j. Portion of a short-styled flower at anthesis, partially dissected, showing calyx, disk, style, and stigmas. —k. Fruit. a–j based on *Domínguez-Licona 1544* (MEXU); k based on *Domínguez-Licona 1732* (MEXU).

carpa); its deeply lobed calyx limbs 0.8–1.5 mm long, with the lobes relatively narrow, usually unequal in length on an individual flower, and typically spreading (vs. calyx limbs 0.3–0.5 mm long and undulate to only shallowly lobed with the lobes generally uniform and ascending in *P. erythrocarpa*); and its habitat in dry seasonal forests of the Pacific coast of Mexico (vs. *P. erythrocarpa*'s range in moist seasonal forests on the Caribbean and southern Pacific slopes of Mexico and Guatemala). This new species has also been confused (in herb., MEXU) with *P. mexiae* Standley, which is widespread in Mexico; *P. mexiae* can be separated very easily from *P. chamelaensis* by its leaves with 10 to 13 pairs of secondary veins (vs. 5 to 8 pairs in *P. chamelaensis*), its petioles 3–25 mm long (vs. 1–5 mm long in *P. chamelaensis*), its glabrous stipules 10–40 mm long (vs. hirtellous or strigillose to glabrescent and 4.5–8 mm long in *P. chamelaensis*), its subtruncate calyx limb ca. 0.3 mm long (vs. deeply lobed and 0.8–1.5 mm long in *P. chamelaensis*), and its habitat in wet and premontane forests at 400–1800 m.

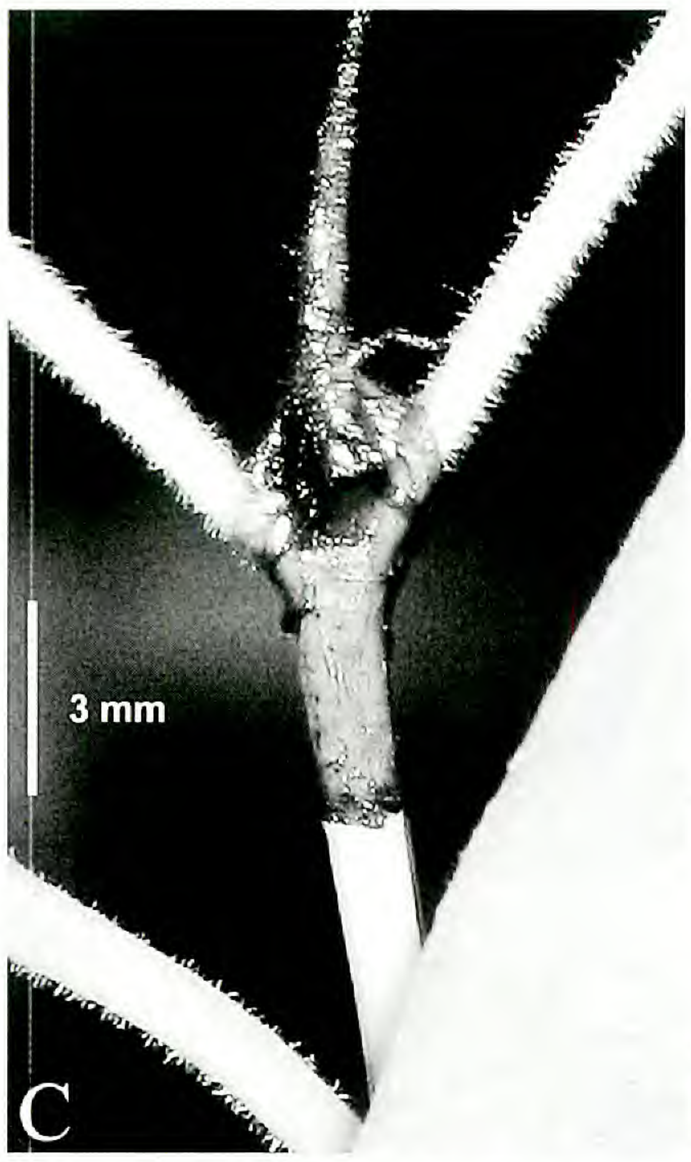
The Chamela Biological Station of the Institute of Biology of the National Autonomous University of Mexico (UNAM) was established in 1971 to promote scientific research on the flora, fauna, and ecosystems of the Pacific coast in Mexico (Hernández, 2002) and the conservation of one of the country's most important ecosystems, seasonally dry tropical forest (Trejo & Dirzo, 2000). It comprises 3200 ha and is one of the four core areas of the Chamela-Cuixmala Biosphere Reserve, which was established in 1993 (Noguera et al., 2002). A large amount of research has been conducted at this Biological Station, making it one of the better-studied ecosystems in the Neotropics (Noguera et al., 2002), but floristic treatments are limited to checklists available for the Chamela Biological Station (Lott, 1985), Chamela Bay (Lott, 1993), and the Chamela-Cuixmala Biosphere Reserve (Lott, 2002).

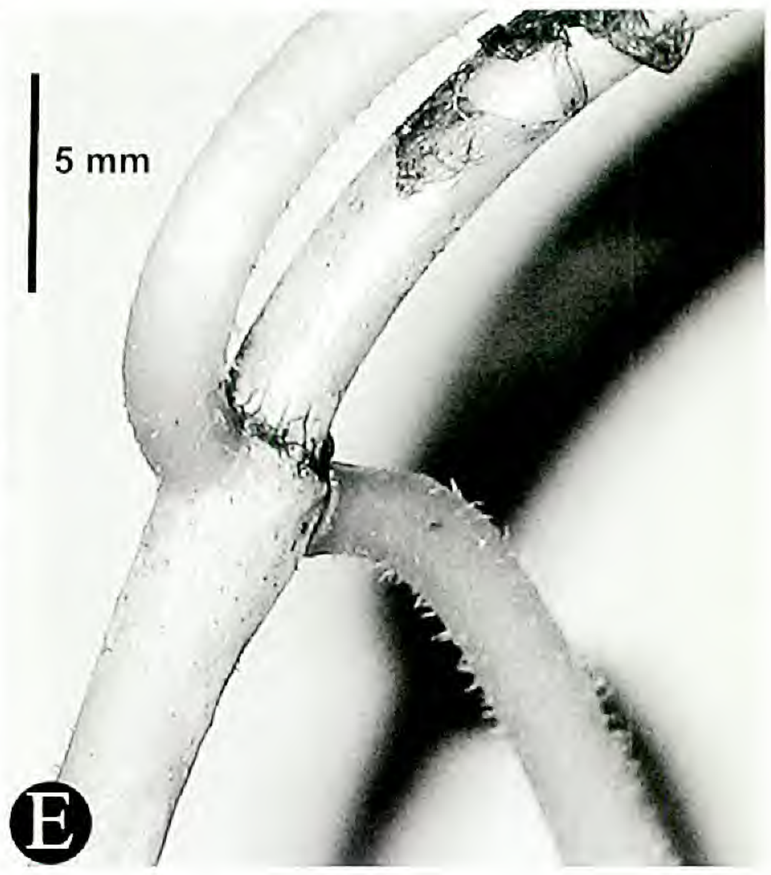
The new species described below was discovered during ongoing floristic study of the Chamela Biological Station by the second and third authors. This work has been focused on the Rubiaceae as a pilot project for the preparation of a complete modern flora of this station, including conventional and electronic formats. The bark description below follows Junikka (1994).

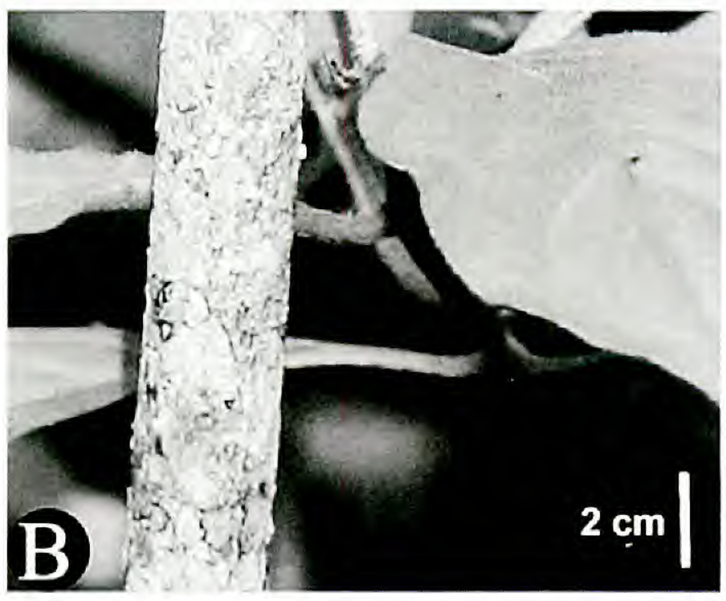
Psychotria chamelaensis C. M. Taylor & E. Domínguez-Licona, sp. nov. TYPE: Mexico. Jalisco: Mpio. La Huerta, Chamela Biological Station, cañada del arroyo "El Zarco," en la vereda Chachalaca a 920 m, 19°30′N, 105°03′W, 40 m, 20 July 2003, *E. Domínguez-Licona 1544* (holotype, MEXU; isotypes, BR, CBG, IBUG, K, MO, PRE). Figures 1, 2.

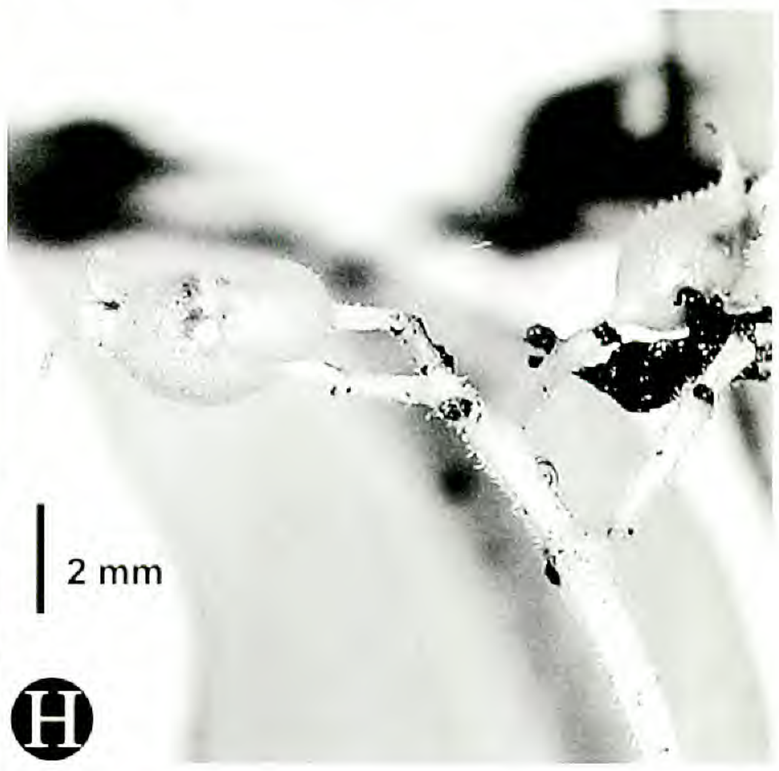
Haec species a *Psychotria erythrocarpa* foliorum cauliumque pubescentia plerumque adpressa atque limbi calycini longioris lobulis angustis bene evolutis distinguitur.

Shrubs flowering at 1.5 m tall, to 3 m tall, DBH to 2–8 cm; stems glabrous. *Bark* soft, heterogeneous to mosaic-mottled with red and green, with fissures less than half as deep as total bark thickness, "V- shaped" to flattened or rounded, less than 15 cm long, parallel to irregularly reticulated, without intermediate crests, with scales thin, adherent, irregularly clumped, less than 7.5 cm long, irregularly shaped or infrequently rectangular, with lenticels rounded, up to 3 mm diam., sparse to solitary, soft, dry to the touch. *Leaves* elliptic to elliptic-oblong, oblanceolate, or obovate, 3.5–11 × 1.2–4.5 cm, at apex obtuse to acute or a little acuminate with the tips to 3 mm long, at base cuneate to acute, drying membranaceous, on both surfaces evenly and moderately to densely strigillose or short-hirtellous; secondary veins 5 to 8 pairs, not looping to interconnect, in most abaxial axils with hirtellous domatia, adaxially venation plane or costa and secondary veins thickened, abaxially costa prominent, secondary veins prominulous, and remaining venation thickened and sparsely visible; margins entire to ciliolate; *petioles* 1–5 mm, hirtellous; *stipules* calyptrate, caducous after apical 1 to 3 nodes, usually splitting along 1 side and shortly persistent as a spathaceous papery structure, 4.5–8 mm long, sparsely to moderately strigillose or hirtellous to glabrescent, at apex very shortly apiculate, the apiculum 0.1–0.2 mm. *Inflorescences* terminal, paniculate, hirtellous; peduncle 1.2–3.5 cm, slender; branched portion pyramidal to rounded-corymbiform, 1–3 × 2.5–5 cm; secondary axes 2 to 3 pairs, sometimes closely grouped to subverticillate; axes rather slender, those of the highest order to 2 mm; bracts triangular to narrowly so or linear, acute, those subtending secondary axes 0.3–1 mm, those subtending flowers or pedicels up to 0.5 mm or frequently these structures ebracteate; pedicels 0–0.5 mm. *Flowers* distylous, sessile and pedicellate in dichasial cymules of 3 to 7; hypanthium cylindrical to turbinate, ca. 0.8 mm, hirtellous; *calyx limb* 0.8–1.5 mm, hirtellous, lobed for 1/2 to almost completely, the lobes 5, linear, sometimes unequal by as much as 50% on an individual flower, often spreading; *corolla* funnelform, white, externally glabrous, internally glabrous except densely pilose at stamen insertion (i.e., in upper part of tube and extending into throat), tube 2–2.5 mm, lobes 5, triangular, ca. 2 mm, acute, abaxially with a low rounded thickening ca. 0.1 mm high; *anthers* in long-styled form ca. 1 mm, partially exserted, in short-styled form ca. 1 mm, exserted on filaments ca. 2 mm, these inserted in upper part of corolla tube; *stigmas* 2, in long-styled form ellipsoid,









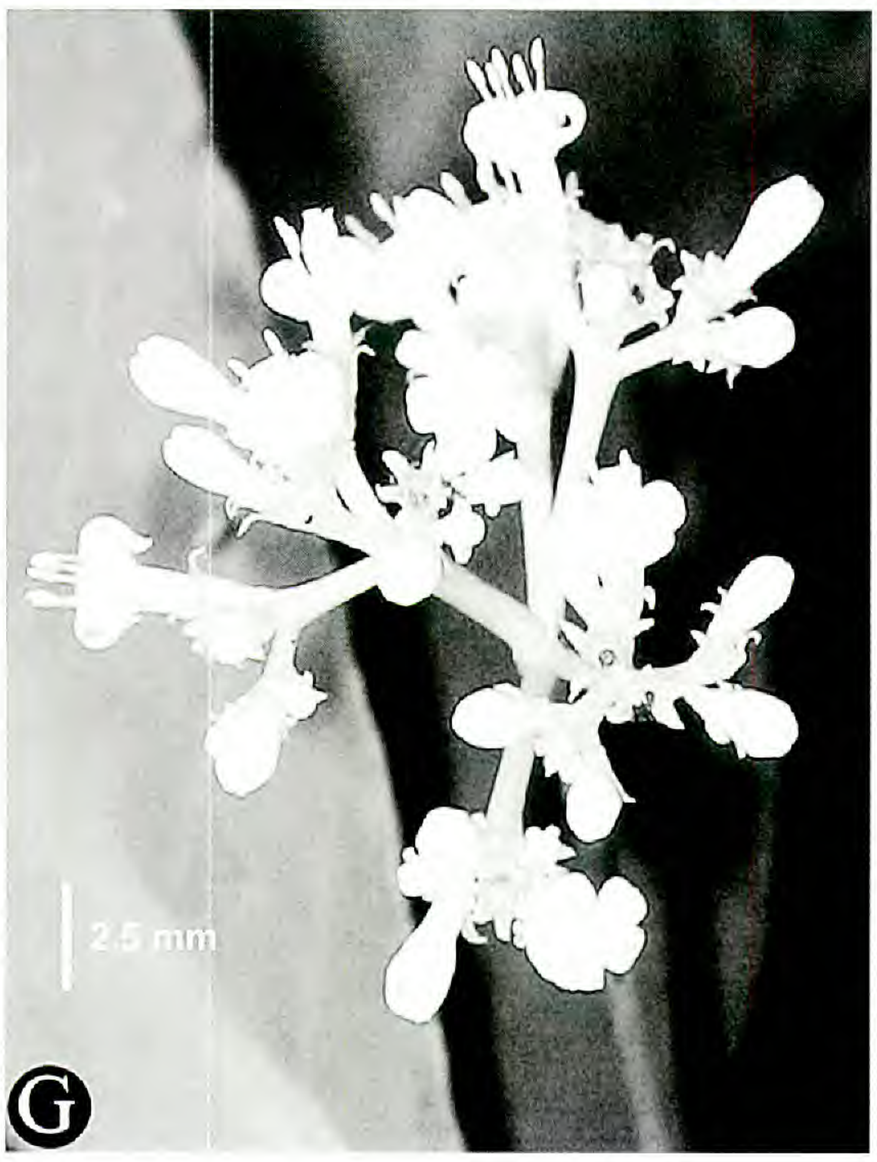


Figure 2. *Psychotria chamelaensis* C. M. Taylor & E. Domínguez-Licona. —A. Habit. —B. Detail of bark. —C. Stem apex showing young stipule. —D. Portion of stem showing two nodes with old stipules and one node (upper) from which stipule has fallen. —E. Portion of stem showing a node from which stipule has fallen and fragments of old stipule adhering to internode in upper part of photo. —F. Inflorescence. —G. Close-up of inflorescence. —H. Immature developing fruits. —I. Infructescence. —J. Mature fruits. A–E, H based on *Domínguez-Licona 1622* (MEXU); F, G based on *Domínguez-Licona 1544* (MEXU); I based on *Domínguez-Licona 1698* (MEXU); J based on *Domínguez-Licona 1732* (MEXU).

ca. 0.3 mm long, exserted on a style ca. 3.5 mm, in short-styled form linear, 0.5–0.8 mm, included, situated near or just above middle of corolla tube; disk annular, ca. 0.5 mm high. *Infructescences* similar to inflorescences or spreading to pendulous, peduncles to 4 cm long (whether these elongate in fruit or they were originally longer on the plants collected in fruit than on flowering plants is unknown); *fruit* ellipsoid, 4–5 × 4–4.5 mm, glabrous, red, juicy; pyrenes 2, planoconvex, dorsally with 4 to 5 low rather flattened ridges, ventrally plane with a shallow central longitudinal sulcus, this a rather straight-sided excavation.

Distribution, habitat, and phenology. Central-western Mexico, in seasonal dry forests, riparian vegetation and *Quercus* woodlands at 30–500 m; collected in flower in July and August, in fruit August to October.

The species epithet refers to the Chamela Biological Station, where this species has been frequently collected.

Paratypes. MEXICO. **Jalisco:** Mpio. La Huerta, 5 km al S de la Huerta, *J. Rzedowski 14693* (MEXU); Chamela Biological Station, without detailed location, *J. A. S. Magallanes 3078* (MEXU), *J. A. S. Magallanes 3115* (MEXU), *L. A. Pérez J. 144* (MEXU), 16 Aug. 2003, *T. Valdivia s.n.* (MEXU); cruce del sendero Tejón con Camino Antiguo Norte, *A. Domínguez M. 318A* (MEXU); intersección del Eje Central y el sendero Calandria, *A. Domínguez M. 445* (MEXU); Camino Antiguo Sur a 760 m, cerca del afluente principal del arroyo "El Zarco," *E. Domínguez-Licona & C. Skov 1529* (MEXU); a ca. 330 m hacia el N de las instalaciones de la Cañada 2, ladera E, *E. Domínguez-Licona et al. 1547* (MEXU); vereda Calandria a 40 m, *E. Domínguez-Licona et al. 1569* (MEXU); vereda Ardilla a 1200 m, *E. Domínguez-Licona 1575* (MEXU); Camino Antiguo Norte a 250 m, *E. Domínguez-Licona et al. 1622* (MEXU); vereda Tejón a ca. 980 m, *E. Domínguez-Licona 1627* (MEXU); instalaciones de la Cuenca 3 a ca. 320 m al E del cruce de Chachalaca y el arroyo "Zarco," *E. Domínguez-Licona & E. Pascual 1650* (MEXU); a 300 m al NW de la parte alta de la Cuenca 2 ca. 300 m al NE de Chachalaca a 1000 m, *E. Domínguez-Licona et al. 1677* (MEXU); final del Camino Antiguo Sur, ca. 140 m al E por el cauce del arroyo "El Zarco," *E. Domínguez-Licona & V. Hernández 1698* (MEXU); a ca. 4.7 km de la unión de los ríos Colorado y Hornitos caminando por el lecho del primero, *E. Domínguez-Licona & M. Becerril 1730* (MEXU); Camino Antiguo Norte a ca. 490 m, *E. Domínguez-Licona 1732* (MEXU); vereda Chachalaca a 200 m, *J. A. S. Magallanes 4257* (MEXU); ca. del arroyo Paillés, *L. A. Pérez J. 279* (MEXU); Cuenca 2, 22 Aug. 2003, *C. Skov s.n.* (MEXU); Chachalaca y Tejón, *T. Valdivia 1* (MEXU).

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New Combinations and Species-level Synonyms in *Swartzia* (Leguminosae: Papilionoideae)

Benjamin M. Torke

Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pennsylvania 19103-1195, U.S.A. torke@ansp.org

Abstract. Based on herbarium and field studies of the Neotropical genus *Swartzia* Schreber (Leguminosae: Papilionoideae), seven new combinations are made: *S. colombiana* (R. S. Cowan) Torke, *S. emarginata* (Ducke) Torke, *S. glabrata* (R. S. Cowan) Torke, *S. kaieteurensis* (R. S. Cowan) Torke, *S. klugii* (R. S. Cowan) Torke, *S. peruviana* (R. S. Cowan) Torke, and *S. polita* (R. S. Cowan) Torke. All of these involve the recognition of former varieties as species due to the discovery of highly correlated morphological discontinuities, often corroborated by geographical and/or habitat separation, among the newly elevated species and closely related species. In addition, some 14 new species-level synonyms are proposed. Notable among these are: *S. aureosericea* R. S. Cowan (synonym of *S. macrosema* Harms), *S. benthamiana* var. *yatuensis* R. S. Cowan (synonym of *S. rosea* Martius ex Bentham), *S. flaemingii* var. *cognata* R. S. Cowan (synonym of *S. polita*), *S. huallagae* D. R. Simpson (synonym of *S. calva* R. S. Cowan), *S. peremarginata* R. S. Cowan (synonym of *S. riedelii* R. S. Cowan), *S. racemosa* var. *major* R. S. Cowan (synonym of *S. klugii*), and *S. stipellata* R. S. Cowan (synonym of *S. anomala* R. S. Cowan).

Resumen. Basado en estudios de herbario y de campo del género neotropical *Swartzia* Schreber (Leguminosae: Papilionoideae), se hicieron siete combinaciones nuevas: *S. colombiana* (R. S. Cowan) Torke, *S. emarginata* (Ducke) Torke, *S. glabrata* (R. S. Cowan) Torke, *S. kaieteurensis* (R. S. Cowan) Torke, *S. klugii* (R. S. Cowan) Torke, *S. peruviana* (R. S. Cowan) Torke, y *S. polita* (R. S. Cowan) Torke. Todas éstas involucran el reconocimiento de variedades como especies, debido al descubrimiento de discontinuidades morfológicas altamente correlacionadas, a menudo corroboradas por separación geográfica y/o hábitat entre las especies recientemente elevadas y las especies cercanamente relacionadas. Adicionalmente, se proponen 14 nuevos sinónimos a nivel de especies. Entre los más sobresalientes están: *S. aureosericea* R. S. Cowan (sinónimo de *S. macrosema* Harms), *S. benthamiana* var. *yatuensis* R. S. Cowan (sinónimo de *S. rosea* Martius ex Bentham), *S. flaemingii* var. *cognata* R. S. Cowan (sinónimo de *S. polita*), *S. huallagae* D. R. Simpson (sinónimo de *S. calva* R. S. Cowan), *S. peremarginata* R. S. Cowan (sinónimo de *S. riedelii* R. S. Cowan), *S. racemosa* var. *major* R. S. Cowan (sinónimo de *S. klugii*), y *S. stipellata* R. S. Cowan (sinónimo de *S. anomala* R. S. Cowan).

Key words: Fabaceae, Leguminosae, Papilionoideae, Neotropics, *Swartzia*.

Ongoing herbarium studies of the large Neotropical tree genus *Swartzia* Schreber (ca. 180 species; Leguminosae: Papilionoideae) have brought to light a number of taxonomic and nomenclatural problems. Many of these have to do with the delimitation of closely related species (Torke, 2004). In the most recent monographic treatment of the genus, Cowan (1968) broadly defined a number of wide-ranging, highly variable species. Some of these definitions united multiple, now morphologically diagnosable entities, often treated as varieties by Cowan. Over the past several decades, dramatic growth in herbarium collections from Neotropical rainforest regions, particularly at the Missouri and New York Botanical Gardens, has allowed more detailed analysis of morphological variation in *Swartzia*. Despite this progress, few assessments of Cowan's species delimitations have appeared in the literature (see Mansano & Tozzi, 1999, 2001).

In preparation of upcoming publications on the molecular phyolgenetics and biogeography of *Swartzia*, this article addresses nomenclatural problems that have become apparent during the course of the author's herbarium and field studies. Following the phylogenetic species concept of Wheeler and Platnick (2000; see also Eldridge & Cracraft, 1980; Nelson & Platnick, 1981; Nixon & Wheeler, 1990), highly correlated morphological discontinuities, especially in combination with geographical or ecological separation, are assumed to yield theoretically justifiable species delimitations. These delimitations should be thought of as testable hypotheses that, when exposed to additional data, particularly genetic data, may turn out to overestimate or, more commonly, to underes-

timate the actual number of diagnosable species in a particular group. New descriptions of the species recognized below are intended in future revisionary works.

1. Swartzia anomala R. S. Cowan, Fl. Neotrop. Monogr. 1: 206–207. 1968. TYPE: Guyana. Upper Takutu–Upper Essequibo: basin of Kuyuwini River, ca. 150 mi. from mouth, 21–26 Nov. 1937 (fr), *A. C. Smith 2591* (holotype, US 1776793; isotypes, MO, NY).

Swartzia stipellata R. S. Cowan, Fl. Neotrop. Monogr. 1: 211. 1968. Syn. nov. TYPE: Brazil. Roraima: Caracaraí, Rio Branco, 20 Sep. 1943 (fl), *A. Ducke 1366* (holotype, US 2248068; isotypes, A not seen, F, MG not seen, NY, R not seen).

Molecular data (Torke, unpublished) and morphology support the monophyly of a group composed of the white-flowered species of *Swartzia* sect. *Possira* (Aublet) DC. as defined by Cowan (1968). As treated here, *S. anomala* is unique within this group in the combination of unifoliolate leaves with the midvein raised adaxially and prominent linear to awl-shaped stipules and stipels. At the time of his monograph, Cowan (1968) knew this species from only six collections, five of which, with relatively large flower buds and flowers, he assigned to *S. stipellata*. Although he did not mention a close relationship between *S. anomala* and *S. stipellata*, the fruiting type collection of the former and the flowering type of the latter differ obviously only in the leaflets smaller and the calyx adaxially pubescent in the type of *S. anomala*. Subsequent collections show that leaflet and flower size vary extensively, but apparently continuously, in a single species distributed primarily from southern Guyana to the central Rio Negro region of Brazil, with a single collection taken from the Rio Madeira basin of Brazil, near the border of Amazonas and Rondônia. Pubescence on the adaxial surface of the calyx occurs sporadically across the distribution of *S. anomala*.

Specimens examined. BRAZIL. **Amazonas:** Rio Negro, São Luiz, betw. Manaus & São Gabriel da Cachoeira, *L. Alencar 139* (NY); Rio Negro, Tapuruquara, betw. Manaus & São Gabriel da Cachoeira, *L. Alencar 282* (NY); Rio Negro, Temendaní, *L. A. Maia et al. 282* (NY); Rio Negro, Ilha Providência to Ilha Arara, *G. T. Prance et al. 16228* (MO, NY, US); N margin of Rio Aracá, just above Igarapé Sauadaua, *G. T. Prance et al. 29857* (MO, NY, US); Rio Negro, near mouth of Rio Aracá, *P. Acevedo-Rodriguez et al. 8067* (US); along Rio Preto (tributary of Rio Negro), 165 km from Barcelos, *P. Acevedo-Rodriguez et al. 8426* (NY, US); Rio Negro, 120 km above Barcelos, *M. T. Madison et al. 6164* (NY, US); Mun. Barcelos, Rio Jauari, after confl. with Igarapé Pretinho, *J. A. Silva 283* (MO, NY, US); Rio Aracá, 13 hours from Barcelos, *J. A. Silva 382* (MO, NY, US); Barcelos, *A. Ducke 7167b* (US); Mun. Humaitá, Humaitá–Porto Velho rd., km 60, margin of Igarapé São João de Agua Clara, *L. O. A. Teixeira et al. 109* (MO, NY, US); Mun. São Gabriel da Cachoeira, rt. margin of Rio Negro, near mouth of Rio Marié, *C. A. Cid Ferreira et al. 9356* (MO, NY, US); Mun. Santa Isabel do Rio Negro, São Tomé, *C. A. Cid Ferreira et al. 9322* (MO, NY, US). **Roraima:** Dormida, foothills of Serra Dalua, *G. T. Prance et al. 9255* (NY, US); Mun. Caracaraí, Caracaraí, Rio Branco, *A. Ducke 1331* (NY, US); North Perimeter rd. (BR-210), 9 km from jct. with Manaus–Caracaraí rd. (BR-174), near Novo Paraíso, *C. A. Cid Ferreira et al. 9207* (MO, NY, US); BR-174, Km 530–540, *C. A. Cid Ferreira et al. 9257* (MO, NY, US); BR-174, betw. Caracaraí & Rio Branco, *L. Coradin & M. dos R. Cordeiro 1050* (NY). GUYANA. **Upper Takutu–Upper Essequibo:** basin of Kuyuwini River (Essequibo River tributary), ca. 241 km from mouth, *A. C. Smith 2591* (MO, NY, US); Kuyuwini Landing, Kuyuwini River, *M. J. Jansen-Jacobs et al. 2443* (BBS, MO, NY, US); Kassikaityu River, 0–3 km E of landing at terminus of trail from Kuyuwini River, *D. Clarke 4836* (BRG, NY, US); S Rupununi Savanna, Wakadanawa Savanna, *M. J. Jansen-Jacobs et al. 5406* (MO, NY, US); S Kassikaityu River, 0–6 km N and E of camp, *D. Clarke et al. 8803* (BRG, NY, US); Acarai Mountains, Sipu River, 7–10 km from confl. with Essequibo River, *T. W. Henkel et al. 5233* (BRG, MO, NY, US).

2. Swartzia calva R. S. Cowan, Proc. Biol. Soc. Wash. 86: 454–455. 1973. TYPE: Peru. Loreto: Maynas, Dist. Alto Nanay, trail to Pisco, 4 km from Santa Maria de Nanay, 130 m, 9 Mar. 1968 (fl), *J. Schunke V. 2509* (holotype, US 2615454; isotypes, F, NY).

Swartzia huallagae D. R. Simpson, Phytologia 30: 313–315. 1975. Syn. nov. TYPE: Peru. San Martín: Mariscal Cáceres, Dist. Tocache Nuevo, Caserío de Cedro, rt. bank of Río Huallaga, 8 Oct. 1970 (fl), *J. Schunke V. 4490* (holotype, F; isotypes, G not seen, US, USM).

In his description of *Swartzia huallagae*, Simpson (1975) appears to have been unaware of the publication of the name *S. calva* by Cowan in 1973. Simpson cited the type collection of *S. calva* (*J. Schunke V. 2509*) as a paratype of *S. huallagae* in the same publication. There are no taxonomically significant differences between the type collections of the two names. *Swartzia calva* occurs in non-flooded lowland Amazonian rainforests in and near the foothills of the Andes Mountains from Pastaza Province of Ecuador south to Huanuco Region of Peru and the Brazilian state of Acre. *Swartzia calva* and its close relative *S. reticulata* Ducke are unique among species of *Swartzia* in having completely glabrous parts. Both species are also characterized by coriaceous leaflets with conspicuous reticulate venation and by large (8–20+ × 4–6.5 cm) woody, more or less elliptical fruits. *Swartzia calva* differs from *S. reticulata* most obviously in its narrower leaflets, which are mostly more than twice as long as

wide (vs. twice as long or less), and in having the style nearly as long as the ovary (vs. much shorter).

Specimens examined. BRAZIL. **Acre:** Mun. Tarauacá, Colocação Morada Nova, Res. Indígena Praia do Carapaná, lt. margin of Rio Tarauacá, basin of upper Rio Juruá, *M. Silveira et al. 1149* (NY); Seringal Universo, *D. C. Daly et al. 8777* (NY). ECUADOR. **Pastaza:** Cant. Pastaza, Pozo Petrolero "Corrientes" de UNOCAL, 35 km SE of Curaray, *S. Espinoza 310* (MO, NY); Curaray (Jesús Pitishka), near airstrip, *G. Harling & L. Andersson 17696* (GB, MO). PERU. **Amazonas:** Monte Virgen, 1 km below La Poza, E bank of Río Santiago, *F. Dominguez-Peña 120* (MO); Río Santiago, 800 m before Caterpiza, E bank of Quebrada Caterpiza, Monte Virgen, *V. Huashicat 361* (MO); Huambisa, valley of Río Santiago, ca. 65 km N of Pinglo, Quebrada Caterpiza, *V. Huashicat 273-A* (MO). **Huánuco:** Prov. Leoncio Prado, Dist. Aucayacu, UTCF, *R. Lao 5010* (MO). **Loreto:** Prov. Alto Amazonas, Puranchim, Río Sinchiyacu, *W. H. Lewis et al. 13293* (USM); Andoas, lt. bank of Río Pastaza, *R. Vazquez & N. Jaramillo 1892* (MO); Prov. Maynas, Res. Nac. Pacaya-Samiria, Pithecia Biol. Stat., Río Samiria, *C. Grández & N. Jaramillo 1971* (MEXU); Nauta, rd. to Iquitos, *R. Vazquez & N. Jaramillo 8645* (AMAZ, MEXU). **San Martín:** Prov. Mariscal Cáceres, Fundo Curareland, near Tinanta, 20 km NW of Tocache, *A. H. Gentry et al. 25689* (AMAZ, US, USM); Dist. Campinilla, rd. to Las Achiras, SW of Caserío de Sión, *J. Schunke V. 3550* (NY, US); Dist. Tocache Nuevo, Balsa Probana, rt. bank of Río Huallaga, *J. Schunke V. 4442* (MO, NY, US); Quebrada de la Cachiyacu, tributary of Quebrada de Huaquisha, *J. Schunke V. 8511* (MO, US, USM).

3. Swartzia colombiana (R. S. Cowan) Torke, comb. et stat. nov. Basionym: *Swartzia brachyrachis* var. *colombiana* R. S. Cowan, Fl. Neotrop. Monogr. 1: 192, fig. 1a. 1968. Syn. nov. TYPE: Colombia. Valle del Cauca: Quebrada Aguadulce, Bahía de Buenaventura, 0–10 m, 11 Nov. 1945 (fr), *J. Cuatrecasas 19728* (holotype, US 2220845; isotype, F).

Five of the ca. 30 taxa that make up the white-flowered portion of *Swartzia* sect. *Possira* were treated by Cowan (1968) as varieties of a single highly variable, wide-ranging species, *S. brachyrachis* Harms. At least three of these taxa are morphologically distinct and are geographically isolated from each other and from other varieties of *S. brachyrachis* and thus should be recognized as separate species. The first of these, *S. colombiana* is the only representative of the white-flowered *Possira* group to be found west of the Andes Mountains. It inhabits lowland rainforests along the Pacific Coast of Colombia in Chocó Department south to Valle del Cauca. One collection was taken from north-central Antioquia, Colombia.

Swartzia colombiana is probably most closely related to *S. peruviana* (R. S. Cowan) Torke, another species treated as a variety of *S. brachyrachis* by Cowan (1968). Both species have 1- to 3(5)-foliolate leaves and differ from other members of the *S. brachyrachis* assemblage in having relatively minute trichomes (mostly less than 0.2 mm long), shorter pedicels (less than 10 mm long), and smaller flowers and flower buds (the buds less than 6 mm diam.). They differ from the typical variety of *S. brachyrachis* in the pedicels and buds densely appressed-pubescent (vs. glabrous) and in shorter stipels (less than 1 mm long), bracts (less than 1 mm long), stipules (mostly less than 2 mm long), and fruit stipes (not more than 10 cm long). *Swartzia colombiana* can be easily separated from *S. peruviana* by its nearly glabrous abaxial leaflet surface (vs. densely golden pubescent in *S. peruviana*). Other unusual features of *S. colombiana* include adaxially prominent, strongly ascending secondary, intersecondary, and tertiary leaflet venation; a deflexed leaflet margin; and raised ridges along one or both sutures of the fruit.

Specimens examined. COLOMBIA. **Antioquia:** betw. Providencia & Quebrada La Tirana, 28 km SW of Zaragoza, valley of Río Anorí, near confl. of Quebrada La Tirana & Río Anorí, ca. 3 km upriver from Planta Providencia, *W. S. Alverson et al. 207* (MO). **Chocó:** near Río Tuado, 12 km W of Istmo de San Pablo, ca. 28 km W of Las Animas, *A. H. Gentry & E. Renteria 23950* (MO, NY, US); Quibdo–Tutunendo rd., ca. 3 km W of Tutunendo, *A. H. Gentry et al. 30176* (MO). **Valle del Cauca:** Rio Yurumanguí, Veneral, *J. Cuatrecasas 15910* (US); Mun. Buenaventura, Bahia de Buenaventura, Quebrada de Buenaventura, *J. Cuatrecasas 19947* (US); Bajo Calima, Carton de Colombia "El Dindo," *H. Murphy 546* (MO, US); Bajo Calima, ca. 15 km N of Buenaventura, "new" Dindo area, *A. H. Gentry et al. 56749* (MO, NY); Bajo Calima, Pulpapel/Buenaventura Concession, La Gasolina hwy., *M. Monsalve B. 1586* (MO); Bajo Calima, betw. Las Quebradas San Joaquín & Aguas Claras, *I. Cabrera R. 3839* (MO); Bajo Calima Concession, ca. 15 km NW of Buenaventura, 1 km past Luchin–Lijal rd. on Luchin rd., *D. Faber-Langendoen & E. Renteria 1205* (MO); Bajo Calima Concession, ca. 25 km NW of Buenaventura, ca. 9 km NW of San Isidro jct. on "Canalete," near gate, *D. Faber-Langendoen & J. A. Hurtado 1683* (MO); Bajo Calima Concession, Juanchaco Palmeras area, ca. 10 km NW of Buenaventura, *A. H. Gentry et al. 57024* (MO); Bahía de Malaga, near mouth of Quebrada La Sierpe, *A. H. Gentry et al. 40431* (MO).

4. Swartzia emarginata (Ducke) Torke, comb. et stat. nov. Basionym: *Swartzia sericea* var. *emarginata* Ducke, Arq. Inst. Biol. Veg. 2(1): 44. 1935. TYPE: Brazil. Amazonas: São Paulo de Olivença, Rio Solimões, 3 Oct. 1931 (fl), *A. Ducke 24238* (holotype, RB not seen; isotypes, K not seen, RB not seen, S not seen, U not seen, US).

Ducke (1935) and Cowan (1968) considered *Swartzia emarginata* to be a variety of *S. sericea* Vogel. Among the apetalous *Swartzia* (series *Tounateae* Bentham), only *S. emarginata* and *S. sericea* have

the combination of the adaxial surface of the calyx densely sericeous and the filaments of the large stamens pubescent. In the available collections, *S. emarginata* and *S. sericea* differ consistently in the size of the pedicels (3–4.5 mm long in *S. emarginata*, 6–10 mm long in *S. sericea*), the flower buds (3.5–4 × 4.5–5 mm in *S. emarginata*, 6–7.5 × 6.5–8 mm in *S. sericea*), the flowers (e.g., the ovary 2.5–3 mm long in *S. emarginata*, 4.5–6 mm long in *S. sericea*), the number of leaflets (7- to 9-jugate in *S. emarginata*, 4- to 6-jugate in *S. sericea*), and the length of the trichomes on the inflorescence axes (less than 0.3 mm in *S. emarginata*, often greater than 0.3 mm in *S. sericea*). In addition, the two species are separated geographically, with *S. emarginata* known only from the vicinities of Fonte Boa and São Paulo de Olivença on the Rio Solimões in the Brazilian state of Amazonas, and *S. sericea* more broadly distributed in the basin of the Rio Negro, from its mouth near Manaus, Brazil, to upper tributaries in the Venezuelan state of Amazonas and adjacent Colombia, with the type collection (probably lost) reportedly taken in French Guiana.

Specimens examined. BRAZIL. **Amazonas:** Mun. Fonte Boa, Grecí, Paraná do Mamupina (tributary of lt. margin of Paraná Mineruá), *C. A. Cid Ferreira et al. 8369* (MO, NY, US); Mun. São Paulo de Olivença, rd. to Bonfim, just outside of São Paulo de Olivença, basin of Rio Solimões, *H. C. de Lima et al. 2784* (MO, NY, US).

5. Swartzia glabrata (R. S. Cowan) Torke, comb. et stat. nov. Basionym: *Swartzia brachyrachis* var. *glabrata* R. S. Cowan, Fl. Neotrop. Monogr. 1: 192, fig. 40a, b. 1968. TYPE: Suriname. Brokopondo: 0.5 km SW of Savanna I, Tafelberg Mountain, 17 Sep. 1944 (fr), *B. Maguire 24779* (holotype, NY; isotypes, A not seen, BR not seen, G not seen, U not seen, UC not seen, US).

Close morphologically to the typical variety of *Swartzia brachyrachis*, *S. glabrata* has similarly large trichomes (often more than 0.3 mm long) and flowers (pedicels 1.5–2.5 cm, flower buds 6–8 mm diam., ovary stipe 6–10 mm, ovary 6–7 mm, style ca. 2 mm). It consistently differs from the typical variety in the pedicels, flower buds, and abaxial calyx surface densely appressed-pubescent (vs. essentially glabrous) and the stipules, stipels, and bracts relatively small and inconspicuous (generally less than 1 mm long). The 1- or 2-jugate leaves are also distinctive in the leaflets essentially glabrous (though sometimes with sparse pubescence on the midrib abaxially) and the venation conspicuously raised on both leaflet surfaces. In addition to these differences, *S. glabrata* appears to be geographically isolated from the typical variety of *S. brachyrachis* of the central and eastern Amazon basin of Brazil, as well as from other members of the *S. brachyrachis* assemblage by a significant geographic disjunction. It occurs in a variety of habitats, including savannas and rainforests, below 800 m elevation in the Pakaraima Mountains and adjacent lowlands of western Guyana, northern Roraima, Brazil, southeastern Bolívar, Venezuela, east to Mount Tafelberg and surrounding lowlands in western Suriname, and south to the Serra Acarai Mountains of southern Guyana.

Specimens examined. BRAZIL. **Roraima:** Serrinha, Rio Mucajaí, *G. T. Prance et al. 4215* (NY); Vila Pacaraima, Rio Surumu, Boa Vista–Pacaraima rd. (BR-174), *S. Almeida & M. Cordeiro 622* (MO). GUYANA. **Potaro-Siparuni:** Iwokrama Forest Reserve, Burro-Burro River, at confl. with Siparuni River, *P. Mutchnick & B. Allicock 540* (BRG, NY, US); Iwokrama Forest Reserve, Burro-Burro River, 2.82 km from Whitewater Base Camp, *K. M. Redden et al. 1136* (US). **Upper Demerara-Berbice:** Upper Demerara River, *G. S. Jenman 4126* (BRG). **Upper Takutu-Upper Essequibo:** Acarai Mountains, near Chodikar Mountain, *D. Clarke 2972* (BRG, NY); Acarai Mountains, height of land betw. drainage of Mapuera River (Trombetas River tributary) & Shodikar Creek (Essequibo River tributary), *A. C. Smith 2993* (MO, NY); Acarai Mountains, Sipu River, 7–10 km from confl. with Essequibo River, *T. W. Henkel et al. 5209* (BRG); British Guiana/Brazil border, Chodikar Trail, near Kukui Creek, *Forest Dept. of British Guiana 7673/658* (NY); Essequibo River, 4 km N of Konashen Rapids & Mount Zibingatzako, *D. Clarke 3226* (BRG, NY); Rupununi area, new rd. to Lethem, to 25 km past Surama village entrance, *P. Acevedo 3434* (BBS, BRG, NY). SURINAME. **Brokopondo:** Tafelberg Mountain, Table Mountain, Savanna No. 1, *B. Maguire 24306* (MO, NY). VENEZUELA. **Bolívar:** Mun. Roscio, "El Abismo," small range S of Río Samay, N of Río Icabaru, *B. K. Holst & R. Liesner 2435* (MO, NY, US).

6. Swartzia kaieteurensis (R. S. Cowan) Torke, comb. et stat. nov. Basionym: *Swartzia lamellata* var. *kaieteurensis* R. S. Cowan, Fl. Neotrop. Monogr. 1: 133. 1968. TYPE: Guyana, Potaro-Siparuni: Kaieteur Savanna, Potaro River, Sep.–Oct. 1881 (fl), *G. S. Jenman 1048* (holotype, K not seen; isotype, BRG).

Swartzia kaieteurensis was treated as a variety of *S. lamellata* Ducke by Cowan (1968), but it is quite distinct morphologically and geographically from the typical variety of that species. The leaflets of *S. kaieteurensis* are more coriaceous than those of *S. lamellata*, the margins are deflexed (plane in *S. lamellata*), and the apex is long-acuminate (cuspidate in *S. lamellata*). The flowers and flower buds of *S. kaieteurensis* are about twice as large (7–8 mm wide) as those of *S. lamellata* (3.5–5 mm wide), and the fruit is verrucose rather than coarsely rugose. *Swartzia kaieteurensis* has been collected in Kaieteur Falls National Park in the Potaro-Siparuni District of

Guyana and near Imbaimadai in the Cuyuni-Mazaruni District. It occurs in forests on sandy soils below 1000 m elevation in the Pakaraima Mountains of Guyana. The nearest collection of *S. lamellata*, a species restricted to the central Amazon Basin, was taken more than 600 km to the south in the Brazilian state of Amazonas.

Other close relatives of *Swartzia kaieteurensis* include *S. rosea* Martius ex Bentham and *S. cupavenensis* R. S. Cowan. *Swartzia kaieteurensis* differs from both of these species in having bracteolate pedicels and slightly longer than wide, distinctly verrucose fruits (vs. usually more than twice as long as wide and smooth to irregularly papillate or tuberculate). The geographic distribution of *S. kaiteurensis* is separated from those of *S. rosea* and *S. cupavenensis* in the Venezuelan state of Amazonas by the intervening mountains of the Guyana Plateau.

Specimens examined. GUYANA. **Cuyuni-Mazaruni:** vic. of Imbaimadai, Mazaruni River, 1.45 km S of Partang River Base Camp, *K. M. Redden et al. 1245* (US); vic. of Imbaimadai, on top of tepui, 1.64 km NE of base camp, *K. M. Redden et al. 1409* (US); Pakaraima Mountains, Imbaimadai, Karowrieng River, toward waterfall 3.73 km E of Base Camp 1, bordering Karowrieng Creek, *K. M. Redden et al. 1490* (US); Pakaraima Mountains, Mazaruni River, NW of Chi-Chi Falls, base of tepui behind Base Camp 2, *K. M. Redden et al. 1640* (US). **Potaro-Siparuni:** Kaieteur National Park, N of Menzie's Landing, N of Kaieteur Falls, *J. J. Pipoly & G. Gharbarran 9983* (BRG, MO); Kaieteur National Park, NE of end of airstrip, at headwaters of Korume Creek, *C. L. Kelloff et al. 1320* (BRG); along trail from Kaieteur Falls to Tukeit, *R. S. Cowan & T. R. Soderstrom 2012* (MO); Kaieteur Savanna, Potaro River, *G. S. Jenman 1048* (BRG).

7. Swartzia klugii (R. S. Cowan) Torke, comb. et stat. nov. Basionym: *Swartzia racemosa* var. *klugii* R. S. Cowan, Fl. Neotrop. Monogr. 1: 129. 1968. TYPE: Peru. Loreto: Mishuyacu, near Iquitos, 100 m, Oct.–Nov. 1929 (fl), *G. Klug 601* (holotype, US; isotype, NY).

Swartzia racemosa var. *major* R. S. Cowan, Fl. Neotrop. Monogr. 1: 130. 1968. Syn. nov. TYPE: Brazil. Amazonas: Mello Franco, 31 Aug. 1943 (fl), *P. H. Allen 3095* (holotype, NY; isotypes, MO; fragment, US).

Cowan's (1968) treatment of *Swartzia klugii* as a variety of *S. racemosa* Bentham is no longer justified, considering the substantial morphological differences and the rather large geographical separation between the two species. *Swartzia klugii* is distributed primarily in non-inundated Amazonian forests in the Loreto region of Peru and in Caquetá and Amazonas, Colombia, with a single collection from adjacent Brazil. It differs from *S. racemosa*, which occurs principally in seasonally inundated forests near the mouth of the Amazon River and nearby tributaries in northeastern Pará, Brazil, in the stipules very small, generally less than 0.5 mm long (vs. 8–15 mm long, though often caducous), the leaflets abaxially glabrous (vs. conspicuously canescent from a dense covering of minute whitish trichomes), the leaflet midrib prominently raised adaxially (vs. submerged and sunken in a furrow), the tertiary and higher order venation conspicuously raised on both leaflet surfaces (vs. submerged to slightly raised and inconspicuous), the inflorescence axes glabrescent to sparsely pubescent (vs. densely appressed-pubescent), and the ovary stipe usually more than twice as long as the ovary (vs. less than twice as long).

Cowan (1968) assigned Colombian and Brazilian collections of *Swartzia klugii* to *S. racemosa* var. *major*, citing longer petioles and larger flower buds than in *S. racemosa* var. *klugii*. While it is true that the type collection of the former name has unusually large flower buds for the species and also atypically thick inflorescence axes, subsequent collections with morphology intermediate between that of the type specimens of the two varietal names suggests that variation in these characters is continuous. Field observations by the author in Peru revealed extensive variation in petiole length within populations, often on a single individual. Petiole length appears to be highly correlated with leaflet size, which in turn is correlated with light exposure and plant age.

Specimens examined. COLOMBIA. **Amazonas:** W side of Río Caquetá, betw. Villa Azul & Peña Roja, *A. van Dulmen AvD286* (NY); Río Apaporís, betw. Río Cananari & Río Pacoa, *H. García-Barriga 13870* (NY, US); Río Apaporís, mouth of Río Pacoa, *R. E. Schultes & I. Cabrera 12557* (US); Río Apaporís, Soratama, near mouth of Río Cananari, *R. E. Schultes & I. Cabrera 14824* (NY); Mun. Leticia, Corr. Puerto Santander, Río Caquetá, mouth of Río Meta, Finca El Refugio, 135 km from Araracuara, *D. Cárdenas et al. 4578* (NY); Mun. Tarapacá, Corr. Tarapacá, Parq. Nac. Nat. Amaycayacu, Lorena Sect., Río Cotuhé, *A. Rudas et al. 5190* (MO). **Caqueta:** Río Yari, 10 km from mouth, *D. Cárdenas & F. Andoque 4323* (MO); vic. of Araracuara, El Engaño, 2–3 km above outlet, *D. Restrepo & A. Matapi 598* (NY). PERU. **Loreto:** Quebrado Tahuayo, above Tamishiyaco, *T. B. Croat 19875* (MO, US); Río Tambor-yaca, *T. B. Croat 20566* (MO, NY); Prov. Maynas, ca. 7 km E of oil palm plantation at Río Manití, ca. 20 m above level of Quebrada Paparo, *K. Ruokolainen et al. 5091* (USM); Cahuide, Río Itaya, *R. Vásquez & N. Jaramillo 5738* (AMAZ, MO, USM); Mamepo, Río Yubineto (tributary of Río Putumayo), *C. Haxaire 858* (MO); Quebrada Yanamono, Explorama Tourist Camp, Río Amazonas, betw. Indiana & mouth of Río Napo, *R. Vásquez & N. Jaramillo 6344* (MO); Dist. Alto Nanay, Rio Nanay, Quebrada de Anguilla, *M. Rimachi Y. 3471* (AMAZ); Dist. Las Amazonas, Quebrada Sucursari (tributary of Río Napo), *A. H. Gentry et al. 54330* (MO); Explornapo Camp, near Sucusari, Río Napo, *J. Pipoly et al. 13473* (MO, USM); Llachapa, Explornapo Camp, Río Napo, *R. Vásquez & N. Jaramillo 3777* (MO); Dist. Iquitos, Allpahuayo-Mishana Res. Zone, Exp. Stat. of IIAP, *R. Vásquez & N. Jaramillo*

14765 (MO, NY); Yuto Village, Yuto Lake, Río Nanay, Allpahuayo-Mishana Res. Zone, *R. García et al. 1630* (AMAZ); Mishana, Río Nanay, halfway between Iquitos and Santa Maria de Nanay, *A. H. Gentry et al. 26140* (US, USM); Río Nanay, close to village of Mishana, *K. Ruokolainen et al. 808* (AMAZ, USM); Río Nanay, betw. Mishana and Puerto Almendras, *A. H. Gentry et al. 21083* (USM); Río Nanay, settlement of Nina Rumy, *J. Ruíz 762* (AMAZ, MO); Puerto Almendras, property of the Univ. de la Amazonía Peruana, Río Nanay, above Iquitos, *B. M. Torke et al. 260* (AMAZ, MO); Mishuyacu, near Iquitos, *G. Klug 574* (NY, US); Pangana, near Quebrada, above Aucaya, *S. McDaniel & M. Rimachi Y. 30241* (MO, NY); Río Momón (tributary of Río Nanay), trail from comm. "Grau Second Zone" to Quebrada de Leonidas, *M. Rimachi Y. 3442* (AMAZ); Río Momon, trail to San Miguel ranch, 1 hour from port of Bellavista, *M. Rimachi Y. 8037* (MO, NY, US, USM); Dist. Nauta, Río Marañón, Quebrada de Sapira, comm. of Florida, 8 km above Nauta, *M. Rimachi Y. 4352* (AMAZ, NY, US); Dist. Sangento Lores, Constancia Norte, Shapajillal, *R. Vásquez et al. 22988* (MO); Prov. Requena, Saquena, Río Ucayali, Quebrada de Aucayacu, San Pedro, above Genaro Herrera, *M. Rimachi Y. 4304* (MO).

8. Swartzia macrosema Harms, Notizbl. Bot. Gart. Berlin-Dahlem 9: 970. 1926. TYPE: Peru. Loreto: Prov. Alto Amazonas, Río Marañón, at mouth of Río Santiago, Pongo de Manseriche, 1924 (fl), *G. Tessmann 4217* (lectotype, designated by Cowan, 1968: 50, S not seen; isotypes, F, NY).

Swartzia aureosericea R. S. Cowan, Brittonia 37: 301–302. 1985. Syn. nov. TYPE: Ecuador. Zamora-Chinchipe: just N of Yantzaza, 700 m, 16 Nov. 1982 (fl), *T. D. Pennington & G. Tenorio 10754* (holotype, K not seen; isotype, US).

Cowan (1985) distinguished *Swartzia aureosericea* from its nearest relative, *S. macrosema*, based on the type collection's relatively larger, differently shaped stipules, leaflets, and bracts; longer petioles; greater number of secondary veins in the leaflets; and aureosericeous leaflet undersurface. Inspection of available collections assignable to either name from throughout the range of the complex exposed nearly continuous variation in all of these characters, with little or no geographic correlation. In living individuals examined by the present author in Peru, the aureosericeous pubescence on the leaflet undersurface was most conspicuous in relatively young leaflets and was often caducous in older leaflets. Based on these observations, it is suggested that there is a single species, *S. macrosema*, occurring in non-flooded, lowland and premontane rainforests near the base of the Andes Mountains from Putomayo Department of Colombia south to Amazonas region of Peru.

Specimens examined. COLOMBIA. **Putumayo:** margins of Río Guamués, betw. San Antonio & mouth, *J. Cuatrecasas 11224* (US). ECUADOR. **Morona-Santiago:** Río Cuyes, 10 km W of Río Zamora, 5 km SW of (Río?) Gualaquiza, *M. A. Baker 6853* (MO, NY); Bomboiza, 17 km SE of Río Gualaquiza, *J. Zaruma 342* (MO, NY); Bomboiza, Salesiana Shuar Mission, *D. Neill et al. 7404* (MO, NY). **Napo:** 8 river km above Puerto Misahualli, rt. bank of Río Napo, Res. Flor. Jatun Sacha, *J. Zaruma 771* (MO, NY). **Pastaza:** Mera, *E. Asplund 18819* (NY, S). **Zamora-Chinchipe:** lt. bank of Río Nangaritza, near Miasi, *J. Jaramillo 14288* (MO, NY); Cant. El Pangui, Cord. del Cóndor, valley of Río Quimi, W of ridge, *D. Neill et al. 12935* (MO); Cant. Nangaritza, comm. Shuar Zarentzaq, near confl. of Río Numpatakaime & Río Tzenganga, *W. Quizhpe et al. 473* (MO). PERU. **Amazonas:** Prov. Bagua, Aramango, *F. Woytkowski 5626* (MO, US); rt. bank of Río Santiago, 2–3 km above mouth, *J. J. Wurdack 2403* (NY, US, USM); Dist. Imaza, comm. Yamayakat, along Río Marañon, opposite Imacita, trail to Putuin, *B. M. Torke et al. 250* (HUT, MO); comm. Yamayakat, Quebrada Kusu-Chapi, *R. Vásquez et al. 19393* (MO); Aguaruna comm. Kusú-Listra, Cerro Apág, margin of Quebrada Kusú, *C. Diáz et al. 8621* (MO, USM); Tayu Mujaji, comm. Wawas, *R. Vásquez et al. 24619* (MO); Putuim–Shimutaz rd., *R. Vásquez et al. 21280* (HUT, MO, USM); Bagua–Imacita rd., betw. Chiriaco & Imacita, *B. M. Torke et al. 251* (HUT, MO).

9. Swartzia peruviana (R. S. Cowan) Torke, comb. et stat. nov. Basionym: *Swartzia brachyrachis* var. *peruviana* R. S. Cowan, Fl. Neotrop. Monogr. 1: 194. 1968. Syn. nov. TYPE: Peru. Ucayali: Prov. Coronel Portillo, Dist. Calleria, forestry breeding area, Km 4, 8 July 1963 (fl), *R. L. Majin 55* (holotype, US 2407941; isotypes, NY, USM).

With a dense mat of minute, appressed golden trichomes (each less than 0.2 mm long) completely concealing the abaxial leaflet surface and with its particularly small flowers (e.g., pedicels 3.5–5 mm, flower buds ca. 3–4 mm diam., ovary stipe 2.5–4 mm, ovary ca. 2.5–3 mm, style ca. 1–1.5 mm), *Swartzia peruviana* is the most distinct species in the *S. brachyrachis* assemblage. The venation, submerged to slightly raised on the adaxial leaflet surface and relatively inconspicuous on the abaxial surface, is also characteristic. In addition, the species differs from the typical variety of *S. brachyrachis* in its densely pubescent inflorescence axes, pedicels, and flower buds; its much smaller stipules, stipels, and bracts (all less than 1 mm long vs. 1–several mm long); and its fruit, with the persistent style less than 2 mm long and the stipe not more than 10 mm long and less than 1 mm thick in the center.

Swartzia peruviana is a large canopy tree known mostly from non-inundated Amazonian rainforests of the Loreto and Ucayali regions of Peru to Pando and Beni Departments of Bolivia. It may also occur in poorly collected adjacent areas in western Brazil. It was encountered by the present author growing on nutrient-poor lateritic clay soils in the Basin of the Rio Beni in Bolivia. The species appears to be geographically separated from other members of the

S. brachyrachis assemblage, which are found in the Guyana shield and in central and eastern parts of the Amazon basin.

Specimens examined. BOLIVIA. **Beni:** Cachuela Esperanza, Rio Beni, "Yuta" rd., *B. Maguire 125* (NY); Prov. Vaca Diez, 17 km E of Riberalta on rd. to Guayaramerin, then 2 km NE on old rd. to Cachuela Esperanza, *B. M. Torke et al. 243* (MO, USZ). **Pando:** Prov. Abuná, Encampment 18 to Democracia, 18 km N of Barraca San Juan de Nuevo Mundo, N of Río Orton, *L. Vargas et al. 608* (LPB); ca. 5 km NE of rubber center of Ingavi & Río Orton, *L. Vargas & R. Foster 754* (USZ); Prov. Manuripi, 12 km W of Conquista-Trampolín, *St. G. Beck et al. 20148* (LPB). PERU. **Loreto:** Prov. Maynas, Dist. Iquitos, Allpahuayo-Mishana Res. Zone, Exp. Stat. of IIAP, *R. Vásquez et al. 18343* (AMAZ, MEXU, MO); Allpahuayo-Mishana Res. Zone, Iquitos–Nauta rd., Km 20, ca. 35 km SW of Iquitos, *A. H. Gentry et al. 56106* (MO, USM); Iquitos, Itaya Plantation, Iquitos–Nauta rd., Km 42, *R. Vásquez & T. Soto 8318* (MO); Prov. Requena, Dist. Saquena, Río Ucayali, trail from Quebrada Aucayacu, above Genaro Herrera, *Manuel Rimachi Y. 4249* (AMAZ, MO, NY, USM). **Ucayali:** Prov. Colonel. Portillo, Dist. Calleria, forestry breeding area, Km 4, *R. L. Magin 70* (NY, USM).

10. Swartzia polita (R. S. Cowan) Torke, comb. et stat. nov. Basionym: *Swartzia flaemingii* var. *polita* R. S. Cowan, Proc. Biol. Soc. Wash. 86: 455–456. 1973. TYPE: Brazil. Bahia: Maraú, 12 Jan. 1967 (fl), *R. P. Belém & R. S. Pinheiro 3078* (holotype, US 2639671; isotypes, CEPEC, NY).

Swartzia flaemingii var. *cognata* R. S. Cowan, Proc. Biol. Soc. Wash. 86: 456. 1973. Syn. nov. TYPE: Brazil. Bahia: Coarací, 30 Nov. 1966 (fl), *R. P. Belém & R. S. Pinheiro 2944* (holotype, US 2639670; isotype, NY).

Cowan (1968) erected *Swartzia* ser. *Acutifoliae* R. S. Cowan for an apparently natural assemblage of species that have five to 20 leaflet pairs, white corollas, the style shorter than the ovary, the ovary stipe shorter than or not more than 1.25 × the length of the ovary, and broadly elliptical, usually multiseeded fruits, with the seeds partially covered by yellow arils. Most of the ca. 20 species assignable to the series have bracteolate pedicels. The series is distributed primarily in coastal rainforest and restinga areas of eastern Brazil and, to a lesser extent, in dry, seasonal, and riparian forests and cerrado regions of central Brazil, with some species occurring as far north as the southern tributaries of the Amazon river in Pará and as far west as eastern Bolivia. Many of the taxa in series *Acutifoliae*, especially in eastern Brazil, are geographically restricted endemics. A scarcity of collections from much of the geographic range of the series precluded a detailed analysis of morphological variation by Cowan (1968, 1973, 1981), and as a result, a number of distinct species were either not recognized or were treated as varieties of *S. acutifolia* Vogel, *S. flaemingii* Raddi, or *S. macrostachya* Bentham. Inadequate sampling also led to the opposite error, the inference of morphological discontinuities where none actually existed. While some of these problems were corrected by Mansano and Tozzi (1999, 2001), several others remain to be addressed, and a thorough revisionary study of the series throughout its geographic range is sorely needed.

Among the five varieties of *Swartzia flaemingii* recognized by Cowan (1968, 1973), variety *polita* and variety *cognata* are unique in the morphology of their leaves (mostly 12- to 20-jugate, with the rachis winged and the leaflets narrowly oblong, marginally revolute, coriaceous, glabrous and usually highly lustrous on the adaxial surface, and appressed-pubescent on the abaxial surface) and in having (4 to) 6 to 14 large stamens. In addition to these characters, these two varieties differ from the typical variety of *S. flaemingii* in the pedicels 12–22 mm long (vs. 5–10 mm long) and the bracteoles less than 1 mm long (vs. 1.5–3 mm long). In the original publication (Cowan, 1973), the two varieties, each known at the time from only a single collection, were separated by the leaflets being more conspicuously revolute and lustrous above and more densely pubescent beneath in variety *polita*, and by the greater number of larger stamens in variety *cognata* (10 to 12 vs. 4 to 6 in var. *polita*). With recent collections bridging the morphological discontinuities between the type specimens, the varietal names are no longer tenable, and a single taxon, *S. polita*, is recognized. The species is known only from a narrow strip of coastal rainforest and restinga vegetation in the Brazilian state of Bahia, between Salvador and the border with the state of Espírito Santo.

Specimens examined. BRAZIL. **Bahia:** Camaçari–Canavieiras road, 25 km E of Camaçari, Faz. Santa Terezinha, *J. Almeida & T. S. Santos 235* (CEPEC); Mun. Belmonte, Belmonte–Itapebi rd., 30 km SW of Belmonte, *B. M. Torke et al. 163* (CEPEC, MO); Mun. Cairú, Nilo Peçanha–Cairú rd., Km 2, *A. M. Carvalho et al. 362* (CEPEC); Mun. Coarací, *R. P. Belém & R. S. Pinheiro 2944* (NY, US); Mun. Ilhéus, W portion of Mata da Esperança, access Ilhéus–Itabuna rd., Banco da Vitória, *J. G. Jardim et al. 2600* (CEPEC, NY); Faz. Nossa Senhora de Fátima, Km 2 of rd. to Japu, *L. A. Mattos Silva et al. 3523* (CEPEC); Mun. Ipiaú, rd. to Jequié, *T. S. Santos 1208* (CEPEC, US); Mun Itacaré, *T. S. Santos 1070* (CEPEC, US); Itacaré-Maraú rd., Km 4, *Mattos-Silva et al. 4356* (NY); Mun. Maraú, Maraú–Campinhos rd., Km 1, *G. P. Lewis & A. M. de Carvalho 1019* (NY, US); Ubaitaba–Maraú rd., 45.5 km E of Ubaitaba, *J. G. Jardim et al. 2605* (CEPEC, MO, NY, US); Ubaitaba–Campinhos rd., Km 60–62, *T. S. Santos et al. 4547* (CEPEC); Mun. Porto Seguro, Res. Biol. do Pau-Brasil, *A. Eupunino 62* (CEPEC, US); Mun. Santa Cruz Cabrália, Est. Ecol. Pau-Brasil, ca. 16 km W of Porto Seguro on Hwy. BR-367, Parque Zoobotânico, *F. S. Santos 222* (CEPEC); Mun. Teixeira de Freitas, Alcobaça, *T. S. Santos 937* (CEPEC, US); Mun. Uruçuca, Uruçuca–Taboquinha rd., *T. S. Santos 2199* (CEPEC, NY, US); 7.3 km N of Serra

Grande on rd. to Itacaré, *W. W. Thomas et al. 7522* (CEPEC, NY).

11. Swartzia riedelii R. S. Cowan, Fl. Neotrop. Monogr. 1: 161–162. 1968. TYPE: Brazil. Bahia: near Ilhéus, Jan. 1822 (fr), *L. Riedel 607* (holotype, LE not seen; isotypes, NY, US).

Swartzia peremarginata R. S. Cowan, Proc. Biol. Soc. Wash. 86: 457–458. 1973. Syn. nov. TYPE: Brazil. Bahia: Mun. Una, margin of Una–Olivença rd. (BA-001), 1 June 1966 (fr), *R. P. Belém & R. S. Pinheiro 2377* (holotype, NY; isotypes, CEPEC, US).

Swartzia ser. *Tounateae* is represented in the Atlantic coastal forest of eastern Brazil primarily by a morphologically variable complex with mostly glabrous gynoecia. Within this group, Cowan (1968, 1973) recognized four varieties of *S. apetala* Raddi and two other species, *S. riedelii* and *S. peremarginata*. Mansano and Tozzi (1999) reduced the number of varieties of *S. apetala* to two (*S. apetala* var. *apetala* and *S. apetala* var. *glabra* (Vogel) R. S. Cowan), though their analysis was restricted mostly to the southern half of the distribution of the complex. Two other species of series *Tounateae* with densely pubescent gynoecia, *S. capixabensis* Mansano, known from a single collection from Espírito Santo, and *S. pilulifera* Bentham of Minas Gerais and Rio de Janeiro, appear to be quite distinct from other members of the series in eastern Brazil.

Cowan (1968) described *Swartzia riedelii* from a single flowering collection from coastal Bahia. He distinguished it from other species in series *Tounateae* by the rachis not winged, the leaflets abaxially tomentose, and the basal portion of the gynoecium sparsely villous-pubescent. A fruiting collection, also from coastal Bahia and reportedly differing in having rigid, obovate, deeply emarginate leaflets (vs. apically short-acuminate) and regular calyx segments with thickened, relatively well-differentiated margins (vs. irregular segments), was described as *S. peremarginata* (Cowan, 1973). Additional collections examined by the present author are quite variable in the shape of the leaflet apex, with some collections having both emarginate and short-acuminate leaflets (e.g., *Thomas et al. 10961*; *Torke et al. 154*). Contrary to Cowan's (1973) assertion that the calyx of *S. peremarginata* is regularly divided into well-defined segments, the calyces of specimens assignable to either name split open in an irregular fashion as in most other species of *Swartzia*. Finally, the presence of sparse pubescence on the ovary stipe and base of the ovary was noted in a number of collections; this character shows little correlation with other supposedly diagnostic features. With the elimination of any taxonomically significant differences between *S. riedelii* and *S. peremarginata*, the older name, *S. riedelii*, is retained for a single species known from coastal white-sand restingas between Ilhéus and Cananvieiras, Bahia.

Specimens examined. BRAZIL. **Bahia:** Mun. Canavieiras, Canavieiras–Santa Luzia rd., *A. A. Amorim et al. 2113* (NY); Mun. Eunápolis, *A. J. Ribeiro et al. s.n.* (CEPEC); Mun. Ilhéus, 10 km S of Ilhéus (Pontal) on rd. to Olivença, then 3 km W, Faz. Manquinho, *W. W. Thomas et al. 10194* (MEXU, NY, US); rd. to Marium (off rd. to Vila Brasil), 8.9 km SW of Olivença, *W. W. Thomas et al. 10961* (NY); Faz. Barra do Mánguinho, Ilhéus–Olivença rd. (BA-001), Km 11, *R. Voeks 12* (CEPEC); Olivença–Vila Brasil rd., Km 3, near Faz. Cururupitangal, *L. A. Mattos Silva et al. 1725* (CEPEC); Olivença, *T. S. Santos 2856* (CEPEC, US); Olivença–Serra das Trempes rd., 6 km from Olivença, *W. W. Thomas et al. 9715* (NY); Mun. Una, rd. to Distr. de Pedras, ca. 7 km past jct. with BA-001, *B. M. Torke et al. 154* (CEPEC, MO); BA-001, 26 km S of Olivença, *S. A. Mori & F. P. Benton 13268* (CEPEC, US); BA-001, just N of bridge on Rio Acuipé, ca. 30 km S of Ilhéus, *S. A. Mori et al. 16621* (CEPEC, NY, US); Una Biol. Res., headquarters, km 46 of Ilhéus–Una rd. (BA-001), *A. M. Amorim et al. 1626* (NY, US); Una Biol. Res., near Picada do Principe, *A. M. Amorim et al. 1728* (NY); Una Biol. Res., along Rio Marium, *A. M. Carvalho et al. 6465* (CEPEC, NY); Olivença–Una rd. (BA-001), Km 35, ca. 1 km S of entrance to Una Biol. Res., *J. L. Hage & E. B. dos Santos 826* (CEPEC).

12. Swartzia rosea Martius ex Bentham in Martius, Fl. Bras. 15(2): 32. 1870. TYPE: Colombia. Amazonas/Caqueta: Cataract Araracuara, Jan.–Feb. 1820 (fl), *C. F. P. von Martius 3137* (holotype, M).

Swartzia benthamiana var. *yatuensis* R. S. Cowan, Fl. Neotrop. Monogr. 1: 137. 1968. Syn. nov. TYPE: Venezuela. Amazonas: uppermost Río Yatua, 100–140 m, 12 Dec. 1953 (fl), *B. Maguire et al. 36753* (holotype, US 2253838; isotype, NY).

The *Swartzia benthamiana* complex (including *S. benthamiana* Miquel, *S. laevicarpa* Amshoff, *S. rosea*, *S. cupavenensis*, *S. fanshawei* R. S. Cowan, *S. triptera* Barneby, *S. lamellata*, *S. kaieteurensis*, *S. tomentifera* (Ducke) Ducke, and *S. ulei* Harms) is a morphologically cohesive group found throughout much of lowland Amazonia and the Guianas. It can be distinguished from other species groups within *Swartzia* by the combination of ramiflorous inflorescences, a white petal, 2 to 4 larger stamens, and a pubescent gynoecium, with the ovary broadly ellipsoid, longer than the style, and about as long as or slightly shorter than the ovary stipe. Most species lack bracteoles and have mostly single-seeded fruits that are more or less elliptical. Morphological diagnosis of species within the complex is based on combinations of subtle character states and is complicated by the presence of occasional intermediate individuals.

As recognized here, *Swartzia rosea* is a widespread, variable taxon that occurs across much of western Amazonia, from eastern Ecuador and Colombia and the Venezuelan state of Amazonas south to the Loreto region of Peru and Acre, Brazil, and east to central Amazonas, Brazil. It is closely related to *S. benthamiana*, *S. laevicarpa*, and *S. cupavenensis*. Although it was treated as a synonym of *S. benthamiana* by Cowan (1968), *S. rosea* differs notably from that species in its fruits, which are papillate or tuberculate in *S. rosea* versus coarsely rugose (i.e., covered with oblique anastomosing ridges) in *S. benthamiana*. The leaflets of *S. rosea* are glabrescent beneath, while those of *S. benthamiana* are usually strigulose. *Swartzia rosea* differs from *S. laevicarpa* most conspicuously in its flower buds, which are globose, densely pubescent, and often verrucose (vs. apically umbonate, glabrescent to sparsely pubescent, and smooth surfaced in *S. laevicarpa*). In addition to these differences, the geographic distribution of *S. rosea* is completely separated from that of *S. benthamiana* of the Guianas and the northeastern Amazon basin of Brazil and is largely separated from that of *S. laevicarpa* of the Rio Negro and central Amazon basins of Brazil, although the distributions of the latter pair overlap somewhat in western Amazonas, where occasional intermediate individuals occur. Less impressive are the differences between *S. rosea* and *S. cupavenensis* of the upper Río Orinoco basin of Venezuela. The latter species typically has smooth-surfaced (vs. verrucose) flower buds and revolute-margined leaflets, which are minutely strigulose (vs. glabrescent) beneath.

Cowan's (1968) description of *Swartzia benthamiana* var. *yatuensis* was based on a flowering collection from Amazonas state of southern Venezuela with notably large leaves and conspicuous leaflet venation. These characters display substantial variation across the ranges of both *S. benthamiana* and *S. rosea*. The glabrous leaves of the type collection of var. *yatuensis* and the tuberculate pods of subsequent collections from the same geographic region suggest conspecificity with *S. rosea*.

Specimens examined. BRAZIL. **Acre:** Mun. Cruzeiro do Sul, RADAM Project, *L. R. Marinho 128* (US); BR-364, Ramal do Pentecoste, Km 10, near Assis Brasil, *P. J. M. Maas et al. 9189* (NY). **Amazonas:** mouth of Río Jutaí, *A. Ducke 20352* (US); Río Curicuriarí, summit of Serra Curicuriarí, *R. E. Schultes & F. López 9840A* (US); Mun. Fonte Boa, Paraná do Mamupina (tributary of lt. margin Paraná Mineruá), Varadouro Ponta da Ariramba, *C. A. Cid Ferreira et al. 8389* (MO, NY, US); Mun. Novo Japurá, betw. Tamandaré & Manguari, along Rio Japurá, *C. A. Cid Ferreira & J. Lima 3627* (MO, NY, US); Vila Bittencourt, confl. of Rio Japurá & Rio Apapóris, *C. A. Cid Ferreira & J. Lima 3687* (MO, NY); Mun. São Paulo de Olivença, São Paulo de Olivença, *A. Ducke 1029* (MO, NY, US); rd. to Bonfim, just outside of São Paulo de Olivença, *H. C. Lima et al. 2768* (MO, NY, US); basin of Rio Solimões, near Palmares, *B. A. Krukoff 8558* (MO, NY, US); basin of Creek Belem, basin of Rio Solimões, *B. A. Krukoff 8990* (MO, NY, US). COLOMBIA. **Amazonas:** Río Caquetá, *A. Ducke 12231* (US); Río Apaporís, Soratama, betw. Río Cananari & Río Pacoa, *H. García-Barriga 14104* (NY, US); Río Apaporís, vic. Cachivera de Jirijirimo, *R. E. Schultes & I. Cabrera 12974* (US); Mun. Araracuara, Río Caquetá, rt. margin, 3 km above Isla Sumaeta, *E. Alvarez et al. 707* (NY); Mun. Tarapaca, corr. Tarapacá, Parq. Nac. Nat. Amaycayacu, Lorena Sector, Río Cotuhé, *A. Rudas et al. 4456* (MO). **Vaupes:** Río Paca (tributary of Río Papurí), Wacaricuara & vic., *R. E. Schultes & I. Cabrera 19533* (US); Mun. Mitú, Mitú & vicinity, along Río Vaupés, betw. Río Yí & Río Kubiyú, *J. L. Zarucchi et al. 1829* (MO, US); Río Vaupés, below Urania, *M. P. Galeano et al. 1844* (MO). ECUADOR. **Napo:** Cant. Joya de Los Sachas, comm. Pompeya, S side of Río Napo, encampment of Maxus, Km 5–7, *A. Grijalva & G. Grefa 304* (MEXU). PERU. **Loreto:** Maynas, La Colpa, Río Yubineto (tributary of Río Putumayo), *C. Haxaire 3682* (MO); Yanamono Explorama Tourist Camp, Río Amazonas, *A. H. Gentry et al. 42831* (AMAZ, MO); Dist. Las Amazonas, Explornapo Camp, near Sucusari, along Río Napo, *J. Pipoly et al. 13827* (MO, USM); Dist. Iquitos, Allpahuayo-Mishana Res. Zone, HAP Exp. Stat., 20 km S of Iquitos, on Iquitos–Nauta rd., *R. Vásquez & N. Jaramillo 15261* (MEXU, MO, NY, USM); Mishana, Río Nanay, halfway betw. Iquitos & Santa Maria de Nanay, *A. H. Gentry et al. 39079* (MO, USM); Puerto Almendras, property of Univ. de la Amazonía Peruana, Río Nanay, *B. M. Torke et al. 262* (AMAZ, MO); Prov. Mariscal Ramón Castilla, Río Esperanza, *R. Vásquez & N. Jaramillo 7311* (AMAZ, MO); Prov. Requena, Dist. Saquena, Río Ucayali, Quebrada de Aucayacu, above Genaro Herrera, *M. Rimachi Y. 4286* (AMAZ, MO, USM). VENEZUELA. **Amazonas:** Mun. Rio Negro, Río Siapa, 500 m NE of mouth of Caño Chimoni, *G. Aymard et al. 10078* (MO, NY); middle part of Río Baria, *J. S. Miller & G. Davidse 1641* (MO, NY, US); upper Río Baria, *A. H. Gentry & B. A. Stein 47299* (MO, NY); swamp forest draining into Río Baría from Río Mawarinuma, *W. W. Thomas et al. 3417* (NY, US); Río Mawarinuma, 1–4 km E of Cerro Neblina Base Camp, *R. Liesner & V. Funk 15817* (MO, NY, US); Río Pacimoni, *J. Velazco 2053* (MO); uppermost Río Yatua, *B. Maguire et al. 36753* (NY); San Carlos de Río Negro–Solano rd., ca. 4 km from San Carlos de Río Negro, *P. Berry & G. Aymard 7027* (MO).

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Passiflora venusta, a New Species of *Passiflora* series *Laurifoliae* (Passifloraceae) from Bolivia

Roberto Vásquez Ch.
Sociedad Boliviana de Botánica, Casilla Correo 3822, Santa Cruz, Bolivia.
rvasquez@cotas.com.bo

Marleen Delanoy
Ghent University, Laboratory for Tropical and Subtropical Agronomy and Ethnobotany, Coupure links 653, 9000 Ghent, Belgium. marleendelanoy@gmail.com

Xavier Scheldeman
International Plant Genetic Resources Institute (IPGRI), Regional Office for the Americas, Cali, Colombia. x.scheldeman@cgiar.org

Patrick Van Damme
Ghent University, Laboratory for Tropical and Subtropical Agronomy and Ethnobotany, Coupure links 653, 9000 Ghent, Belgium. Patrick.VanDamme@UGent.be

Stephan Beck
Herbario Nacional de Bolivia, Universidad Mayor de San Andrés, Casilla 10077, La Paz, Bolivia. lpb.dir@acelerate.com

Abstract. *Passiflora venusta* R. Vásquez & M. Delanoy, a new species of subgenus *Passiflora* L. ser. *Laurifoliae* Killip ex Cervi (Passifloraceae) is described and illustrated. *Passiflora venusta* differs from the other species belonging to this series by a unique combination of characteristics: flowers are large (ca. 12 cm diam.) and solitary; sepals and petals are white outside and red-purple inside; outside, sepal veins are white whereas petal veins are red; corona filaments are long and the outermost rank of filaments is noticeably shorter and thinner than the second rank; and fruits are 3.9–5.9 cm long with an endocarp no more than 0.5 cm thick.

Resumen. Se describe e ilustra *Passiflora venusta* R. Vásquez & M. Delanoy, una nueva especie del subgénero *Passiflora* L. ser. *Laurifoliae* Killip ex Cervi (Passifloraceae). *Passiflora venusta* se diferencia de otras especies de esta serie por una combinación de características únicas: flores grandes y solitarias (ca. 12 cm diam.); sépalos y pétalos blancos en la superficie externa, rojo-morados en la superficie interna; en la superficie externa, las nervaduras de los sépalos son blancas mientras que las nervaduras de los pétalos son rojas; los filamentos internos de la corona son largos y los filamentos externos notoriamente más cortos y delgados que los de la segunda fila; y las frutas tienen 3.9–5.9 cm de largo con un endocarpo de máximo 0.5 cm de ancho.

Key words: Bolivia, *Passiflora*, Passifloraceae, series *Laurifoliae*, Yungas.

Within the subgenus *Passiflora* L. ser. *Laurifoliae* Killip ex Cervi, five species are recognized to occur in Bolivia. These are: *Passiflora chaparensis* R. Vásquez (Vásquez, 1998), *P. fernandezii* L. K. Escobar (Escobar, 1989), *P. nigradenia* Rusby (Killip, 1938), *P. nitida* Kunth (Vásquez, 1998), and *P. riparia* Martius ex Masters (*Krömer, T. & Acebey A 1449 LPB*). We add one new species to this list. Local names given for this species are "granadilla," "maracuyá," "granadilla del monte," "chimchircomo," and "tumbo" (M. Delanoy, pers. obs., 2003). In the area where this species is present, different interviewees stated that the fruit was consumed either fresh or as juice. Because of its attractive and colorful flowers, the plant also has ornamental value.

Passiflora venusta R. Vásquez & M. Delanoy, sp. nov. TYPE: Bolivia. La Paz: Nor Yungas, road to Mururata, 21 Jan. 1984, *R. Vásquez, C. Luer, J.*

Luer & N. Williams 1967 (holotype, LPB; isotypes, GENT, MO). Figures 1, 2.

Passiflora venusta a *P. fernandezii* et *P. nigradenia* differt propter florem grandiorem (ad 12 cm) et corollam et calycem ruber-purpureum, a *P. chaparensi*, *P. riparia* et *P. nitida* differt propter 2 series filamentarum coronae inaequalium amplitudine distincte.

Liana, glabrescent except for puberulent fruits and base of styles; *stems* terete, striate; internodes 3–7 cm; *stipules* 4–6 × 0.5 mm at base, linear-subulate, early deciduous. *Petioles* 7–15 mm, caniculate, with 1 pair of glands of 1 mm diam., round, sessile, adaxially attached above mid-petiole. *Lamina* 8–14 × 3–6 cm, oblong-lanceolate, coriaceous, lustrous, gray-green, glabrous adaxially, pale green abaxially; apex generally abruptly acuminate; base rounded or subtruncate; margin entire. *Flowers* solitary, pendent, ca. 12 cm diam.; *peduncle* 3–5 cm, terete; *bracts* 3–5 × 1.5–2.5 cm, verticillate, concave, ovate-lanceolate; apex acute; base rounded, green; margin with 4 to 6 green scattered glands; *stipe* ca. 6 mm; *hypanthium* campanulate, contracted, ca. 2 cm wide at base, to ca. 3 cm wide at apex, white, with a ring of denticulate processes, 1–2 mm, dark purple, in the inner middle surface; *sepals* white outside, red-purple inside, margin white, 3–5 × 1.5–2.5 cm, oblong-lanceolate, subcoriaceous, keeled and aristate; apex acute, awn ca. 3 mm; *petals* white outside with all veins and veinules red, the red nearly covering the whole basal third, red-purple inside, 4–5 × 1–2 cm, linear-lanceolate-attenuate, membranous; apex obtuse; *corona* filamentous, white, banded with dark purple, filaments in 2 series; outer filaments to 2 cm, ca. 2 mm wide; inner filaments to 4.5 cm, ca. 4 mm wide; *operculum* nonplicate, membranous, strongly incurved, red; *androgynophore* 3.5 cm, white; filaments 1.5 cm, united at base, white; anthers white; *ovary* ca. 5 × 3.5 mm, short-stipitate, ellipsoidal, puberulent, partially surrounded by the united base of the anthers; *styles* erect, pubescent at base, whitish; *stigmas* globose, whitish. *Fruit* 3.9–5.9 × 3.2–4.3 cm, subglobose, edible, epicarp sparsely pubescent, soft, orange-yellow, white-maculate; endocarp 0.2–0.5 cm, white, spongy; pulp edible, sweet; *seeds* obcordate, foveate, 6–8 × 3–5 mm.

Etymology. From the Latin word "venustas" meaning "charm, loveliness, and beauty," in reference to the attractiveness of its flowers.

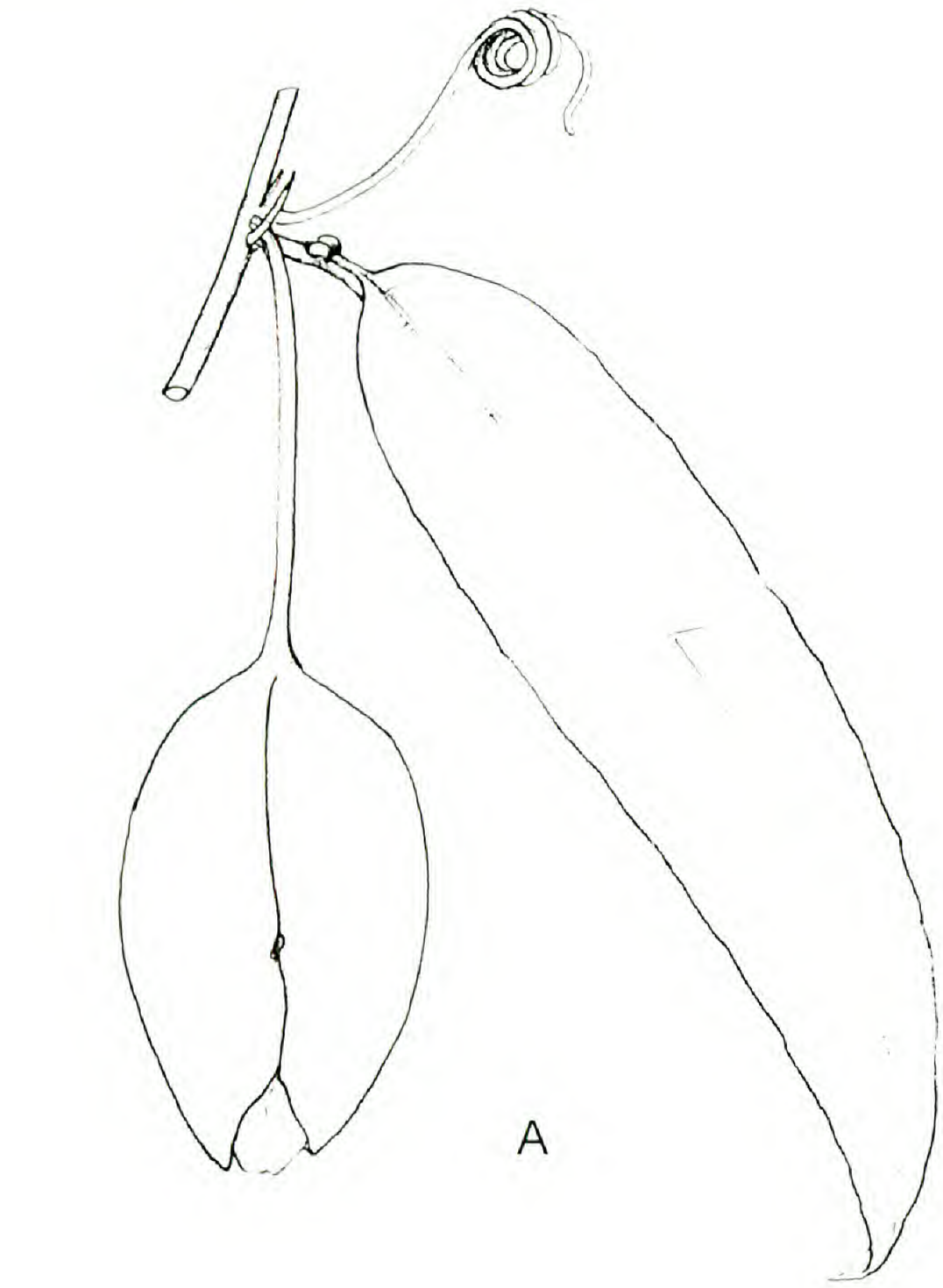
Distribution and habitat. Passiflora venusta is known from collections in Bolivia in La Paz department: Provinces Nor Yungas, Sur Yungas, and Caranavi, and from Beni department: Province Ballivián (Rurrenabaque) (see Fig. 3). It is found on roadsides and trails in the humid forest of the yungas from 575 to 1620 m above sea level.

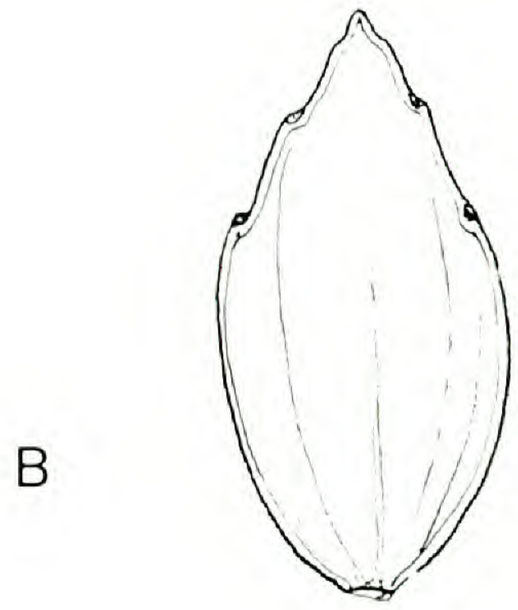
Phenology. Passiflora venusta was found flowering between the end of November and the beginning of February. Ripe fruits were available between December and February.

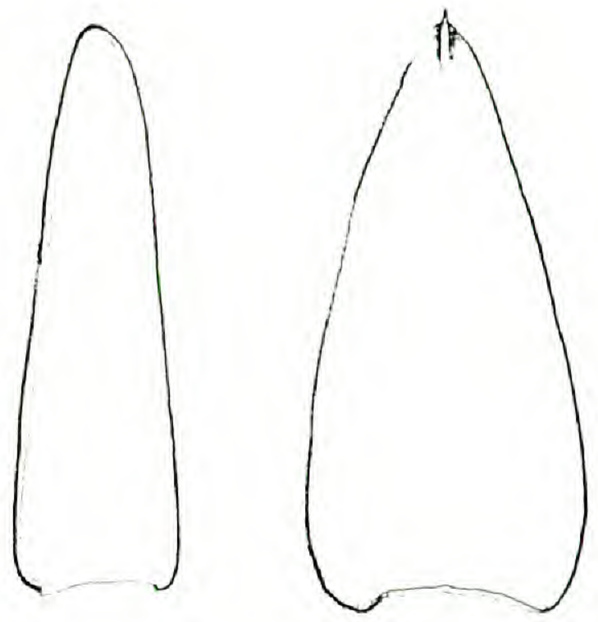
Passiflora venusta is distinguishable from *P. fernandezii* and *P. nigradenia* by its flowers of ca. 12 cm diam. compared to flowers of ca. 6 cm diam. (Escobar, 1989) and 6–10 cm diam. (Killip, 1938; Rusby, 1927), respectively. In addition, *P. fernandezii* is pubescent and has, with its outer corona filaments of 0.6 cm and inner ones of 2.3–2.5 cm, much shorter corona filaments than *P. venusta* (Escobar, 1989). *Passiflora venusta* further differs from *P. nigradenia* and *P. riparia* in having solitary flowers versus flowers borne in groups on short axillary branches (Killip, 1938; Vásquez, 1994, 1998). *Passiflora venusta* also has much smaller fruits with a thinner endocarp than *P. nigradenia* (3.9–5.9 cm vs. 8–10 cm fruits, and 0.5 cm vs. 1.5 cm endocarp, respectively) (Vásquez, 1994, 1998). *Passiflora fernandezii*, *P. nigradenia*, *P. nitida*, and *P. riparia* have white flowers, whereas *P. venusta* has sepals that are white outside and sepals and petals that are colored inside (Escobar, 1989; Killip, 1938; Vásquez, 1998). *Passiflora chaparensis*, *P. nitida*, and *P. riparia* have an outermost rank of corona filaments equaling or exceeding the second rank in contrast with *P. venusta* (Killip, 1938; Vásquez, 1998). *Passiflora venusta* also differs from *P. riparia* and *P. chaparensis* by its glabrous ovary (Killip, 1938; Vásquez, 1998). In addition, *P. venusta* has subglobose fruits, while *P. chaparensis* has pyriform fruits (Vásquez, 1998). Figure 3 shows the distribution of *Passiflora* species belonging to series *Laurifoliae* in Bolivia. *Passiflora venusta* occurs in areas clearly different from those where *P. chaparensis*, *P. fernandezii*, *P. nitida*, and *P. riparia* are reported. *Passiflora nigradenia* has an ample distribution over different departments from Beni and northern parts of La Paz to Santa Cruz. It grows in humid forests from lower areas of the Yungas, between 200 and 1900 m above sea level, whereas *P. venusta* has a limited distribution in the Yungas of the department La Paz. It is found in humid montane forests of the Andes, between 550 and 1650 m above sea level.

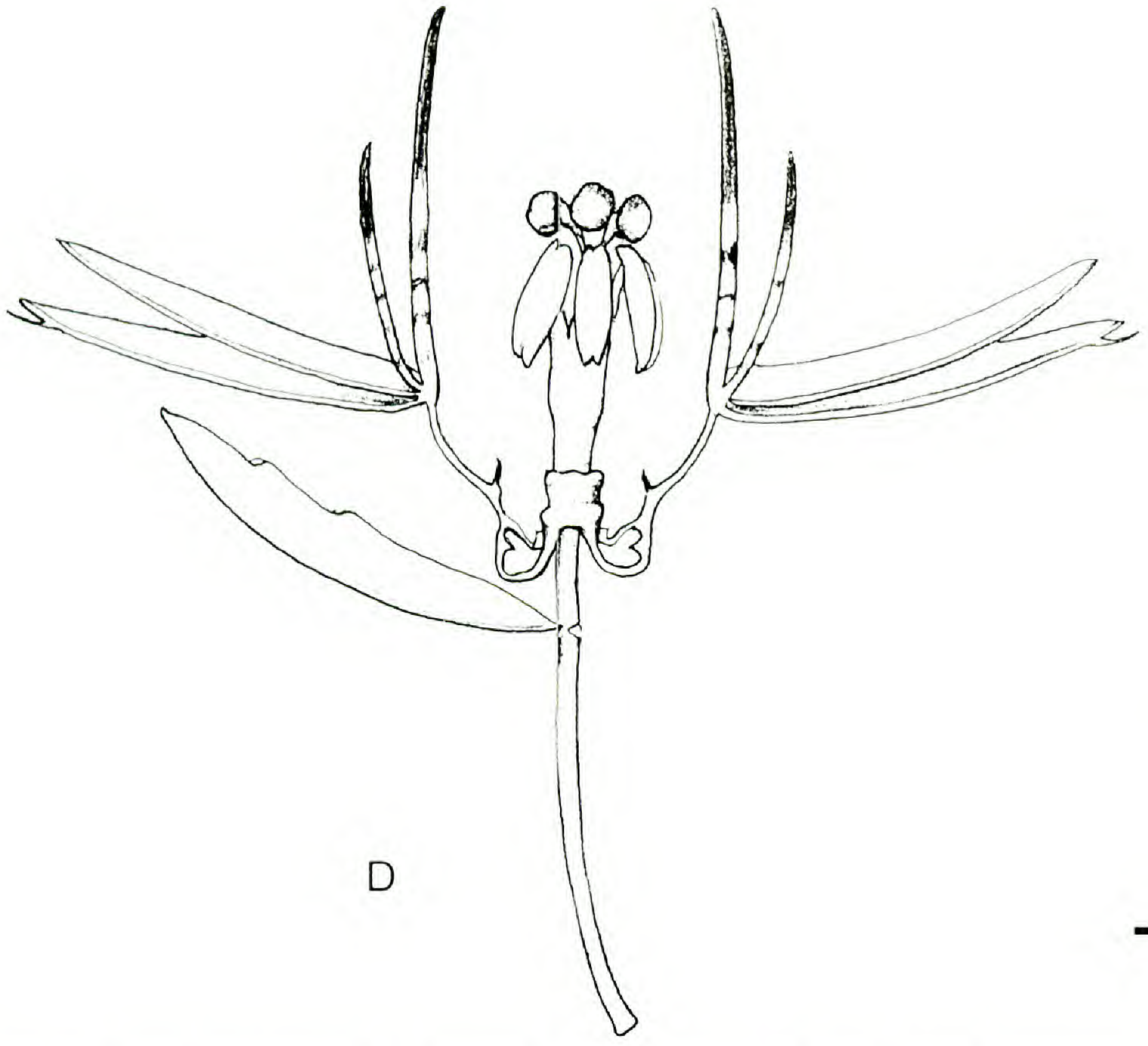
Key to the Species of *Passiflora* ser. *Laurifoliae* in Bolivia

1a. Outermost rank of corona filaments equaling or exceeding the second rank.
  2a. Petioles ca. 1 cm; bracts ca. 5 cm; peduncle 2.5–3 cm, sepals and petals white outside, pink-violet inside . . . . . *P. chaparensis*
  2b. Petioles at least 1.5 cm; bracts less than 4 cm; peduncle at least 3 cm, sepals and petals white.
    3a. Bracts reddish green; flowers generally grouped in short axillary branches with much-reduced leaves, sometimes solitary;









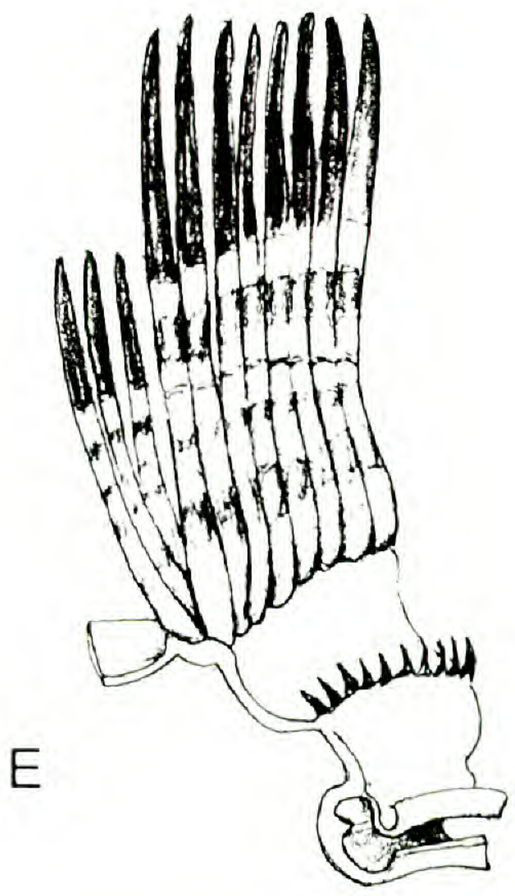


Figure 1. *Passiflora venusta* R. Vásquez & M. Delanoy. —A. Branch with floral bud. —B. Floral bract. —C. Petal (left) and sepal (right). —D. Longitudinal section of a flower. —E. Longitudinal section of corona. Drawing by Roberto Vásquez Ch. from the holotype *R. Vásquez, C. Luer, J. Luer & N. Williams 1967* (LPB).

Figure 2. *Passiflora venusta* R. Vásquez & M. Delanoy. —A. Bud and leaf, abaxial surface. —B. Flower, lateral view. —C. Flower, frontal view. —D. Longitudinal section of a flower. —E. Mature fruit. —F. Longitudinal section of a mature fruit (photographs by Marleen Delanoy).

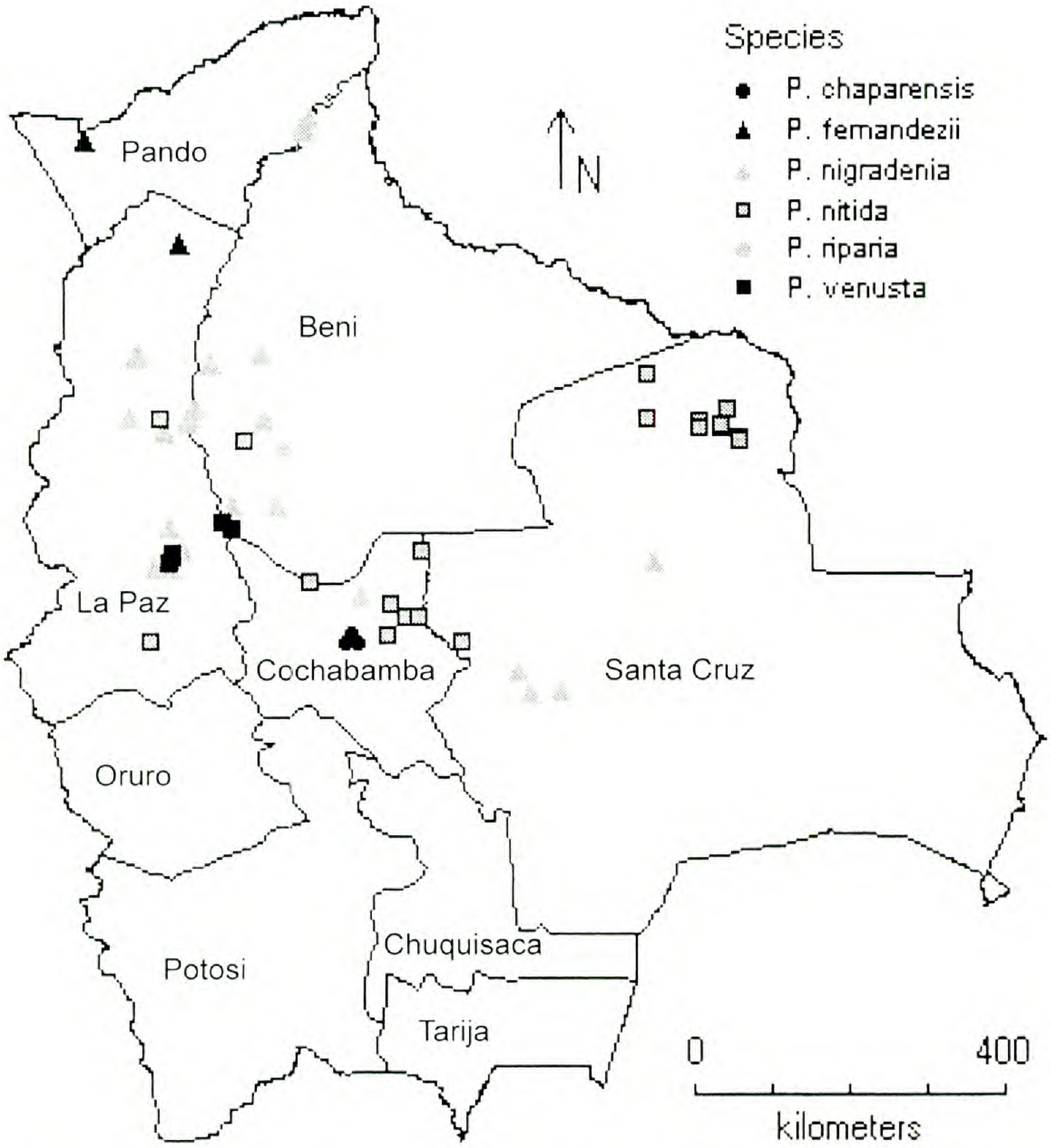


Figure 3. Distribution of *Passiflora* species belonging to series *Laurifoliae* in Bolivia (Delanoy, in prep.).

outer coronal filaments 4–5 cm, the inner ones 0.2 cm; ovary pubescent. . . . *P. riparia*

3b. Bracts green; flowers always solitary; outer coronal filaments 2–3.5 cm, the inner ones about 1 cm; ovary tomentose . . *P. nitida*

1b. Outermost rank of corona filaments shorter than the second rank.

4a. Flowers less than 10 cm wide; sepals and petals white, petals less than 3.5 cm; outer coronal filaments less than 1.5 cm, the inner ones less than 3.5 cm.

5a. Plant pubescent; laminas 5–9.5 × 2.5–4.2 cm; flowers always solitary; outer coronal filaments 0.6 cm. . . . . *P. fernandezii*

5b. Plant mainly glabrous; laminas 12–20 × 9 cm; flowers generally grouped on short axillary branches with much-reduced leaves, sometimes solitary; outer coronal filaments 1–1.3 cm . . . . . *P. nigradenia*

4b. Flowers ca. 12 cm diam.; sepals and petals red-purple inside and white outside; sepal veins white outside but petal veins and veinules red, petals 4–5 cm; outer coronal filaments to 2 cm, inner ones to 4.5 cm . . . . . *P. venusta*

Paratypes. BOLIVIA. **Beni:** Ballivián, Rurrenabaque, 4 Mar. 2000, *R. Vásquez 3702* (herb. Vásquez). **La Paz:** Caranavi, 17 Nov. 1979, *R. Vásquez 1968* (herb. Vásquez); Sud Yungas, Covendo, 5 Mar. 2003, *M. Delanoy 30* (LPB); Remolino, 18 Nov. 2003, *Delanoy 70* (GENT, LPB, MO), 19 Nov. 2003, *Delanoy 71* (BOLV, GENT); Nor Yungas, road from Coroico to Santa Barbara, 26 Nov. 2003, *Delanoy 153, 155, 156, 157* (LPB), 26 Nov. 2003, *Delanoy 151, 161* (GENT, LPB), 26 Nov. 2003, *Delanoy 160* (GENT, US), 26 Nov. 2003, *Delanoy 164* (GENT, LPB, MO); Challa, 28 Nov. 2003, *Delanoy 166, 167* (BOLV, GENT, US); road from Challa to Agua Milagro, 28 Nov. 2003, *Delanoy 174* (LPB, GENT).

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Hoffmannseggella viridiflora (Orchidaceae, Laeliinae), a New Species from Brazilian Campos Rupestres

Christiano Franco Verola

Programa de Pós-graduação em Ecologia, Universidade Estadual de Campinas, Instituto de Biologia, Departamento de Botânica, Laboratório de Biossistemática e Evolução, Cidade Universitária "Zeferino Vaz," s/n° 13083-970, CP 6109, São Paulo, Brazil.
cfverola@yahoo.com.br

João Semir

Universidade Estadual de Campinas, Instituto de Biologia, Departamento de Botânica, Cidade Universitária "Zeferino Vaz," s/n° 13083-970, CP 6109, São Paulo, Brazil

Abstract. The species of the Brazilian genus *Hoffmannseggella* H. G. Jones (Orchidaceae, Laeliinae) are under investigation as part of a biosystematic study. A new species, *H. viridiflora* Verola & Semir, is recognized by differences in morphological characters, such as the spatulate petals and reduced lip, the greenish yellow coloration of the perianth, and the chromosome number, $2n = 44$. Its relationship with closely related taxa, such as *H. bradei* (Pabst) V. P. Castro & Chiron, is discussed.

Resumo. As espécies de *Hoffmannseggella* H. G. Jones (Orchidaceae, Laeliinae), um gênero exclusivamente brasileiro, estão sendo investigadas como parte de um estudo biossistemático. A nova espécie, *H. viridiflora* Verola & Semir, pode ser reconhecida por caracteres diagnósticos como pétalas espatuladas, labelo reduzido, coloração amarelo esverdeado do perianto e o número cromossômico de $2n = 44$. Sua relação com espécies próximas como *H. bradei* (Pabst) V. P. Castro & Chiron é discutida.

Key words: Brazil, cytotaxonomy, *Hoffmannseggella*, Laeliinae, morphology, Orchidaceae, taxonomy.

The Neotropical orchid genus *Hoffmannseggella* H. G. Jones is a member of the subfamily Epidendroideae Kosteletzky, subtribe Laeliinae Bentham. It is one of the most ornamental genera within this subtribe and is distributed only in the Brazilian campos rupestres of Minas Gerais, Rio de Janeiro, Espírito Santo, and Bahia states. Southeastern Brazil, especially Minas Gerais, represents the main center of diversity for plants characteristic of campos rupestres (Harley, 1995; Semir, 1991), including *Hoffmannseggella* (Blumenschein, 1960a, b). Chiron and Castro (2002) recognized 32 species in the genus, but the number has now increased to 42 (Castro & Chiron, 2003; Miranda & Lacerda, 2003; Mota et al., 2003; Campacci, 2005; Chiron & Castro, 2005; Lacerda & Castro, 2005; Miranda, 2005), including *H. viridiflora* Verola & Semir. *Hoffmannseggella* is a taxonomically difficult genus because of the morphological plasticity of species and occurrence of hybridization (Blumenschein, 1960a, b; Van den Berg et al., 2000), and previous generic and specific treatments are in conflict (Schlechter, 1917; Jones, 1968; Pabst & Dungs, 1975; Withner, 1990; Van den Berg & Chase, 2000; Van den Berg et al., 2000; Chiron & Castro, 2002; Van den Berg, 2003).

The range of morphological variation within *Hoffmannseggella*, including hybrids and closely similar species, can lead to difficulties in specific classification and identification. Variation occurs in both vegetative and floral morphology, such as the shape and size of the pseudobulb and the size of leaf, stalk, and pedicel. Floral colors are variable among and within species, including pink, red, orange, yellow, white, and combinations. Perianth characters, such as the shape and ornamentation of the lips and lobes, are associated with other characters (e.g., color and stalk size) and are therefore more diagnostic (Schlechter, 1917; Pabst & Dungs, 1975; Withner, 1990). Other evidence, including cytogenetics, has been useful both in the delimitation of species and in evolution studies in *Hoffmanseggella* (Blumenschein, 1960a, b).

The new species *Hoffmannseggella viridiflora* is here described and illustrated. It can be distinguished from all other species by its greenish yellow flowers, which are the smallest in the genus, together with its apical undulate petals and erect perianth parts.

Material and Methods

Individuals of *Hoffmannseggella viridiflora* and *H. bradei* (Pabst) V. P. Castro & Chiron were collected

from synchronopatric natural populations in Diamantina City, in southeastern Brazil. The plants were maintained in the greenhouse of the Genetic and Evolution Department of the Universidade Estadual de Campinas, São Paulo State. Specimens from the UEC herbarium, as well as those from BHCB, ESA, ESAL, HB, HXBH, MBML, R, RB, SP, and SPF, were examined.

Hoffmannseggella viridiflora Verola & Semir, sp. nov. TYPE: Brazil. Minas Gerais: Diamantina, Conselheiro Mata road, 43°42′W, 18°12′S, 1100 m, 14 Aug. 2003, *C. F. Verola & M. E. Mansanares s.n.* [flowered under cultivation, 12 Dec. 2003] (holotype, UEC 139238). Figure 1.

Haec species *Hoffmannseggellae viridiflorae*, *H. bradei*, *H. itambanae* (Pabst) V. P. Castro & Chiron, *H. verboonenii* (Miranda) V. P. Castro & Chiron et *H. esalqueanae* (Blumenschein ex Pabst) V. P. Castro & Chiron affinis sed floribus viride-flavescentibus, sepalis et labello patentibus brevioribus, petalis spathulatis brevioribus apice undulato, labelli lobo mediano curvato differt.

Perennial rupicolous herb; roots fasciculate, cylindrical, 2.3–3.5 mm; pseudobulbs 41–50 mm, green, 1 or 2 internodes, clavate, basal portion 9–11.3 mm wide to 4.5–5 mm at apex with 2 translucent green, compressed sheaths. Leaf sessile, lanceolate, dark green with purple spots in margins and the abaxial side, 45–48 × 9.5–11.5 mm, smooth, coriaceous, conduplicate, softly reflexed; spathe pale green, asymmetric, oblanceolate, 22–25 × 3.6–4 mm, flattened, softly ventricose on adaxial side. Inflorescence apical, racemiform, stalk 9.1–10 cm, 0.7–1.9 mm diam., erect, rigid, dark green with purple and cream spots, 1 or 2 sterile bracts 3.4–4.2 mm, green, acuminate; raceme 50–55.6 mm, 3- to 5-flowered, erect, rachis green with purple spots, erect; floral bracts translucent, green, triangular, 3.1–4 × 2.5–3.1 mm, persistent, acuminate; pedicel + ovary 23–25 mm, light green, cylindrical. Dorsal sepal brownish yellow adaxially, greenish yellow abaxially, suberect, oblanceolate, 10–10.6 × 3.2–3.7 mm, concave, acuminate; lateral sepals greenish yellow, erect, oblique, oblanceolate, 9–9.5 × 3–3.2 mm, slightly concave, acuminate; petals light greenish yellow, erect, spatulate, 9.5–9.9 × 3.6–4 mm, apically undulate; lip light greenish yellow, erect, trilobate, 6.7–7 × 7.4–7.6 mm, lateral lobes obovate, 6–6.3 × 3–3.2 mm, apex obtuse, tube-shaped and embracing the column, frontal lobe suborbicular, 2.2–2.5 × 2.2–2.5 mm, slightly curved, disc with 4 inconspicuous parallel keels, yellow-ochre; column greenish yellow, subcylindrical, slender, curved, 5.8–6.9 × 2–2.3 mm, subtriangular in transversal section; stigmatic surface deep, subtriangular, 1.4–1.6 mm, separated from the anther by a flexible, viscous and membranous rostellum; anther with 8 cavities, pale yellow, pollinia 8, yellow, dimorphic with 4 smaller. Capsule sulcate, 25–30 × 10–15 mm, delimiting carpels; seeds pale yellow, diminutive.

Etymology. The epithet refers to the greenish yellow color of the perianth of the new species.

Hoffmannseggella viridiflora was collected without flowers from the natural population and cultivated into flower. At first glance, we believed this to be a specimen of *H. bradei* because of the high intraspecific morphological variation and plasticity shown between natural populations of this species. However, comparison of this plant with other closely related species shows that it is a new species, related to the yellow-flowered species of the Diamantina region such as *H. bradei*, *H. esalqueana*, *H. itambana*, and *H. verboonenii*. The new species is closely related to the members of the section *Esalqueanae* (Withner, 1990) that include small plants with short stalks and yellow flowers.

Hoffmannseggella viridiflora flowers in synchronopatry with *H. bradei*, and in this respect it could be a morphological variant of this species. However, their chromosome numbers are different: *H. bradei* has $2n = 40$, whereas *H. viridiflora* has $2n = 44$ (Costa, 2006). *Hoffmannseggella esalqueana* has chromosome number $2n = 40$ (Blumenschein, 1960b). The chromosome number counts for other related species, *H. itambana* and *H. verboonenii*, are unknown. This suggests that *H. viridiflora* may have originated from *H. bradei* by aneuploidy (see Costa, 2006). Aneuploid species are unusual in the genus, where polyploidy prevails in more than 50% of the species (Blumenschein, 1960a, b). Aneuploid complexes were recorded for populations of *H. briegeri* (Blumenschein ex Pabst) V. P. Castro & Chiron (Blumenschein, 1960a) and *H. rupestris* (Lindley) V. P. Castro & Chiron (Costa, 2006). Further corroborating this probable origin of *H. viridiflora* is the low representation of the new species in the original population. Only three individuals were observed for the description, while a few others were unfit to describe, being too old or damaged. They occurred in a mixed population with *H. bradei* and represented about 1% of the total number of individuals of this population. *Hoffmannseggella viridiflora* is endangered because it grows outside a conservation area, in a pasture field near the highway, and is subjected to cattle congestion, occasional fire, and collector action. The endemic status of this species is suggested based on our fieldwork observations and herbarium survey.

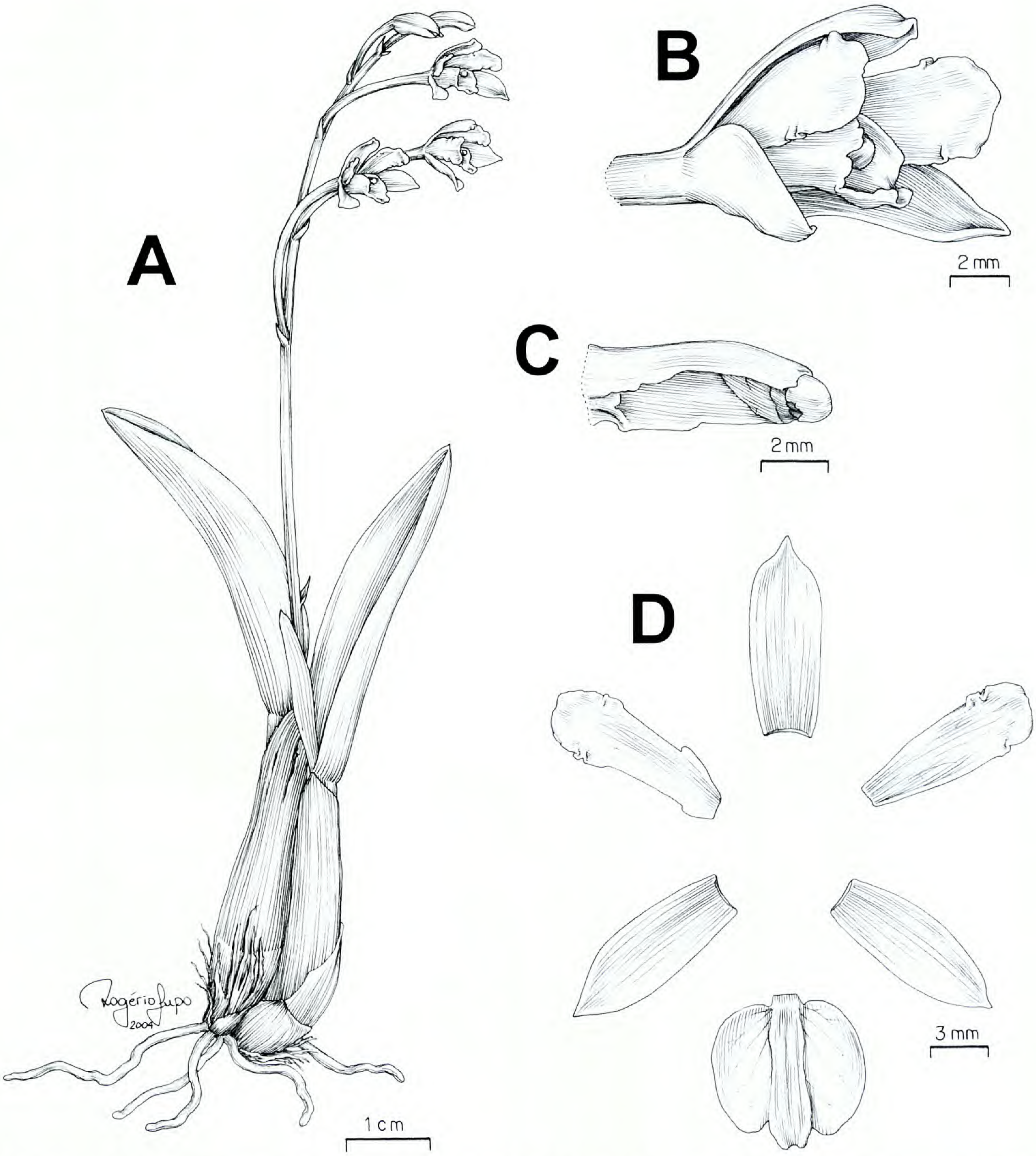

Figure 1. *Hoffmannseggella viridiflora* Verola & Semir. —A. Habit. —B. Flower. —C. Column. —D. Dissected perianth detail. Drawn from the holotype (UEC 139238).

Additionally, an intensive search and georeferenced data bank of natural populations do not indicate another occurrence of this species.

Beyond the cytological evidence, characteristics such as the greenish yellow flowers, the spatulate petals, and the erect portion of the perianth singularly identify this new species. The petals, sepals, and lip are very reduced in relation to related species (Table 1), and the erect midlobe of the lip differs from every other species in the genus due to its recurved shape. The characteristic features of the new species and the differences between *Hoffmannseggella viridiflora* and its related species are summarized in Table 1.

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Table 1. Diagnostic morphological characters of *Hoffmannseggella viridiflora* and closely related taxa. *Characteristics were based on original description, with dashes indicating those not included in descriptions.

Structure	Characters	*H. viridiflora*	*H. bradei* *	*H. esalqueana* *	*H. itambana* *	*H. verboonenii* *
Pseudobulbs	shape	clavate	terete	ovate	terete	elliptical-clavate
	length × width (mm)	41–50 × 9–11.3	40 × 9–10	29 × 8	25–35 × 6–8	30 × 10
Leaf	shape	lanceolate	elliptical	oblong	ovate	linear-lanceolate
	length × width (mm)	45–48 × 9.5–11.5	30 × 15	49 × 14	45 × 25	40 × 10
Floral stalk	length (mm)	91–100	50–60	45	± 40	80
Dorsal sepal	shape	oblanceolate	oblong	oblong-lanceolate	elliptic	lanceolate
	length × width (mm)	10–10.6 × 3.2–3.7	16 × 4	17 × 5	25 × 10	14 × 5
Lateral sepal	shape	oblanceolate	oblong	falcate	ovoid-asymmetric	falcate
	length × width (mm)	9–9.5 × 3–3.2	16 × 5	14 × 5	20 × 12	12 × 5
Petals	shape	spatulate	falcate-tongued	ovate to falcate-tongued	ovate to falcate	lanceolate
	length × width (mm)	9.5–9.9 × 3.6–4	16 × 4	15 × 5	23 × 12	14 × 4.5
	total length × width (mm)	6.7–7 × 7.4–7.6	11 × 9.5	10 × 9	15 × 15	—
Lip	lateral lobe shape / apex shape	obovate to obtuse	ovate to obtuse	ovate to obtuse	semirotund to rotund	subelliptical to falcate
	length × width (mm)	6–6.3 × 3–3.2	8 × 4	—	—	—
Column	length × width (mm)	5.8–6.9 × 2–2.3	5 × 1.75	10 × —	—	6 × 1.2
Pedicel	length (mm)	23–25	18–30	—	40	30

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A New Lithophytic *Orthophytum* (Bromeliaceae) from the Espinhaço Range, Minas Gerais, Brazil

Leonardo M. Versieux
Universidade Federal do Rio de Janeiro/Museu Nacional, Pós-Graduação em Botânica, Quinta da Boa Vista, São Cristóvão, Rio de Janeiro, RJ, Brazil, Cep: 20940-040.
lversieux@yahoo.com.br

Elton M. C. Leme
Herbarium Bradeanum, Rio de Janeiro, RJ, Brazil. leme@tj.rj.gov.br

Abstract. *Orthophytum itambense* Versieux & Leme is described and illustrated as a new species, with an endemic distribution restricted to Pico do Itambé State Park, Minas Gerais, Brazil. This new lithophytic taxon is closely related to *O. supthutii* E. Gross & Barthlott due to the shape and texture of leaves, floral bracts with recurved apex, sessile inflorescence, and by the long tubular corolla. The new species differs from its closest relatives by having leaves white-lepidote abaxially and adaxially, with trichomes forming white transverse cross-bands adaxially, nearly free sepals, white corolla, and shorter petal appendages (only to 4 mm vs. to 7 mm in *O. supthutii*).

Key words: Bromeliaceae, Espinhaço range, IUCN Red List, Minas Gerais, *Orthophytum*.

The number of species of *Orthophytum* Beer has greatly increased since the publication of the last monograph on subfamily Bromelioideae (Smith & Downs, 1979). These authors recognized 17 species, while Luther (2004) lists 35 species for the genus, and the number is now elevated to 47 after studies by Leme (2004a, b), Leme and Machado (2005, 2006), Leme and Paula (2003, 2005), Wanderley and Conceição (2006), and the new species proposed here. Despite the number of new taxa described in the past decades, a modern revision of the genus is still lacking.

Orthophytum is endemic to eastern Brazil, with the center of diversity along the Espinhaço range in Bahia (15 species) and Minas Gerais (7 species) states. Secondary centers occur in the northeastern portion of Minas Gerais state, where at least 13 species occur, restricted to inselbergs, and in the central-north portion of Espírito Santo (7 species). Two additional species range northeast into the adjacent states of Paraíba, Pernambuco, and Alagoas.

Orthophytum grows in sunny and dry habitats or on constantly humid rocks near streams and waterfalls in grasslands on rocky soils in cerrado, among rocks or on rock outcrops inside the dry woodland caatinga, as well as in the Atlantic forest domains.

Orthophytum itambense Versieux & Leme, sp. nov. TYPE: Brazil. Minas Gerais: Santo Antônio do Itambé, Parque Est. do Pico do Itambé, margem esquerda do Rio Preto, próximo à cachoeira da Fumaça, ca. 850 m, 29 Ago. 2003, *L. M. Versieux 149 & A. P. G. Faria* [fl in cultivation, Botany Res. Greenhouse, Univ. Fed. do Rio de Janeiro, 21 Ago. 2004] (holotype, HB; isotypes, BHCB, RFA, SEL, SP). Figures 1, 2C–F, 3.

Species nova *Orthophyto supthutii* E. Gross & Barthlott affinis sed laminis foliorum supra albo-zonatis, sepalis subliberis et etiam petalis albis base appendicibus brevioribus differt.

Plant lithophytic, forming mats, 9 cm high when flowering, short-caulescent, propagating by elongated basal stolons; stolons ca. 10 cm × 3 mm, covered by reduced light brown, narrowly triangular cataphylls, ca. 1.5 cm. Leaves ca. 30, suberect to spreading, arcuate-recurved toward apex at anthesis; leaf sheaths widely ovate-elliptic, 1–1.5 × 2–2.5 cm, glabrous, lustrous, pale yellow becoming greenish yellow and spinulose toward apex; leaf blade narrowly triangular, apex soft, filiform-caudate, (8.5–)12–21 × (0.6–)1–1.7 cm, green, slightly canaliculate toward base, thinner in texture and nearly flat toward apex, abaxially distinctly nerved, subdensely to densely white-lepidote, trichomes asymmetrical, arranged along the midnerves, not obscuring leaf color, adaxially trichomes forming white cross-bands, margins spinulose, spines triangular-uncinate, distinctly antrorse, yellowish green toward apex, 0.5–1 mm long, 2–4 mm apart. Inflorescence sessile, pseudosimple to inconspicuously bipinnate, inconspicuously subcorymbose, sunk in the center of the rosette, ca. 4 × 3 cm, ca. 20-flowered; primary bract foliaceous, gradually reduced in size inward, 7–13 × 1.5–2 cm, becoming yellowish green

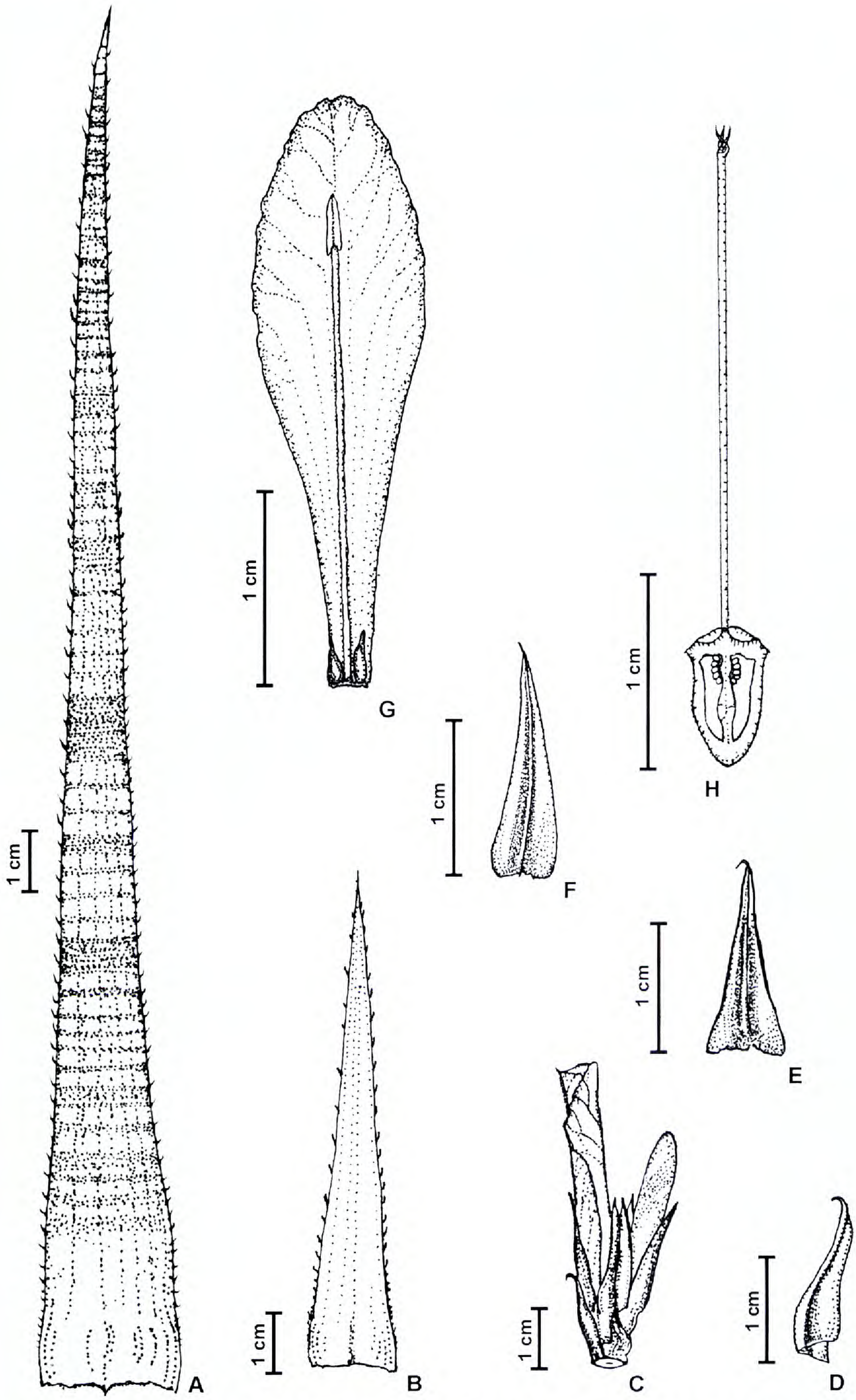

Figure 1. *Orthophytum itambense* Versieux & Leme. —A. Leaf. —B. Primary bract. —C. Fascicle showing a mature flower and a bud. —D. Floral bract, side view. —E. Floral bract, front view. —F. Sepal. —G. Petal and stamen. —H. Stigma, style, and longitudinal section of ovary. Drawn by Leonardo M. Versieux from the holotype, *L. M. Versieux 149* (HB).

or reddish green at anthesis; fascicles ca. 13, inconspicuous, 1- to 2-flowered, ca. 4.3 × 1 cm, compressed, nearly sessile, peduncle complanate, ca. 1 × 5 mm; floral bract narrowly triangular, apex acuminate with a recurved apiculus, 11 × 5–6 mm, membranaceous, glabrous, finely nerved, entire, sharply carinate. Flowers 38–40 mm, sessile or nearly so, odorless or with soft sweet smell, diurnal; sepals

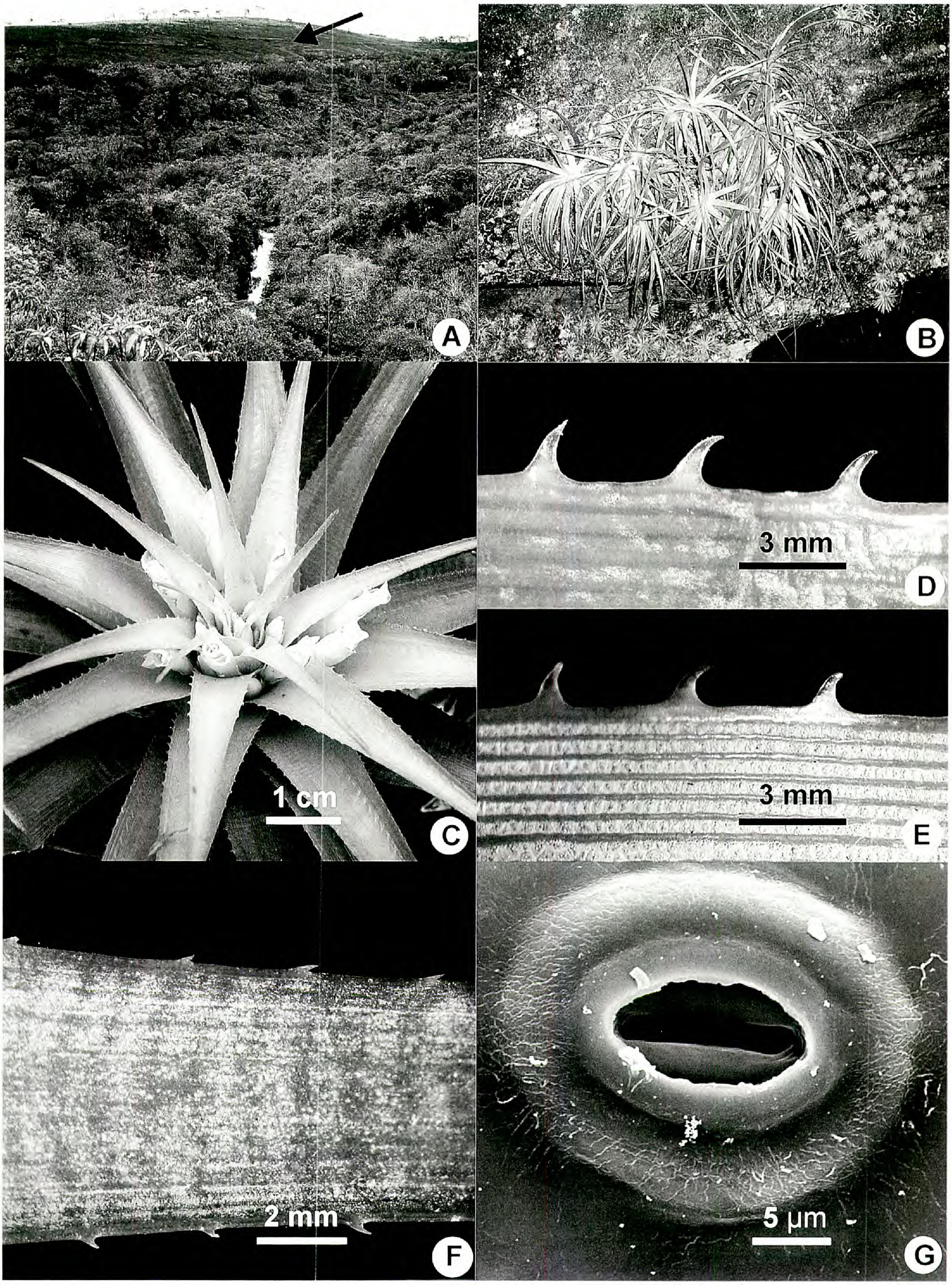

Figure 2. *Orthophytum itambense* Versieux & Leme. —A. Overview of the type-collection locality, showing the gallery forest and land clearing on the top (indicated by arrow). —B. A mat of *O. itambense* overhanging a quartzite outcrop. —C. Adult blooming specimen. —D. Adaxial leaf blade, stereomicroscopic view showing the triangular-uncinate spines. —E. Abaxial leaf blade, stereomicroscopic view showing white trichomes organized in rows, between nerves. —F. Adaxial leaf blade, stereomicroscopic view showing the trichomes forming white transverse cross-bands. —G. SEM image of abaxial epidermis showing one projected stomate. C–G from the holotype, *L. M. Versieux 149* (HB).

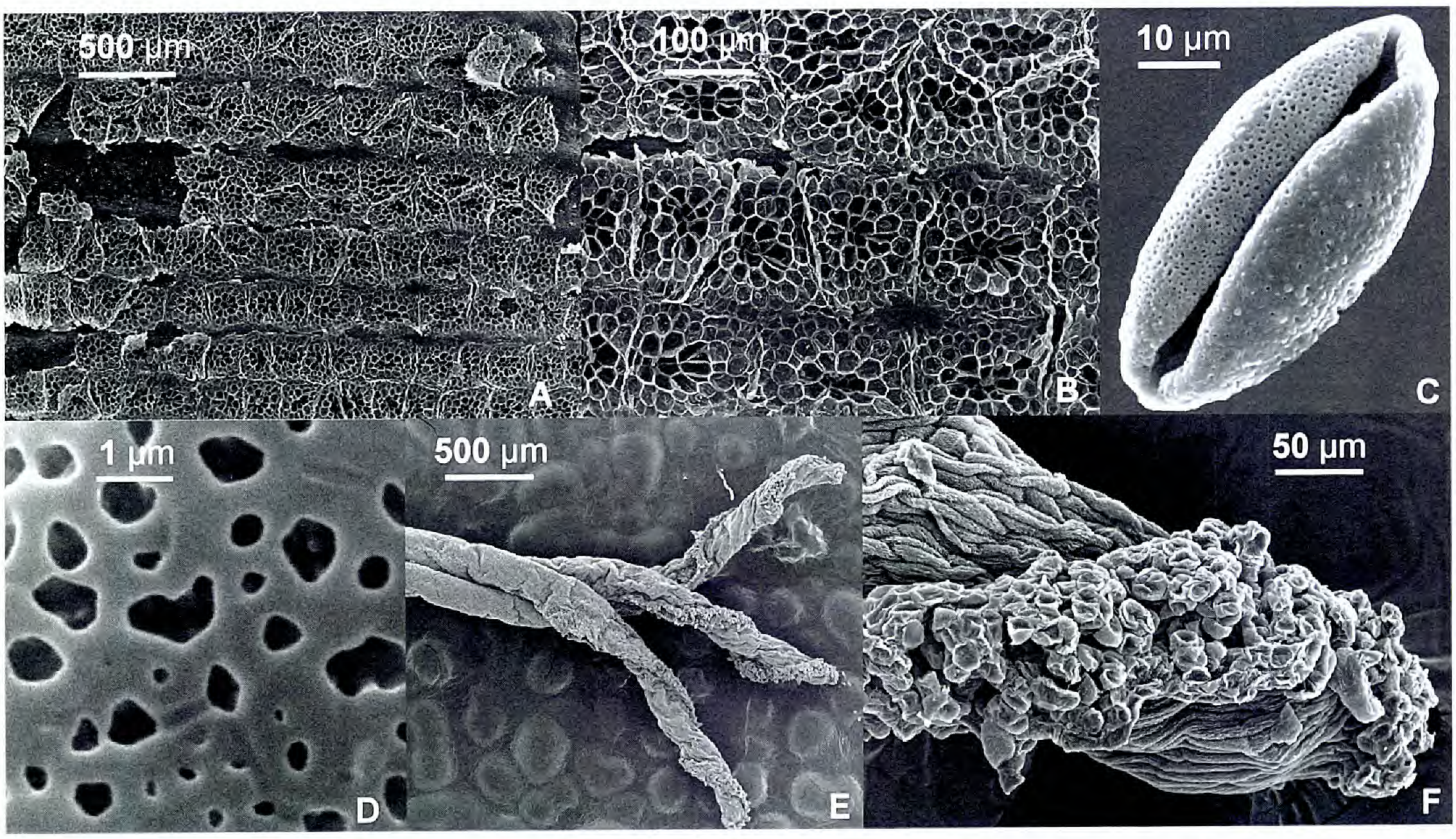

Figure 3. SEM images of different structures of *Orthophytum itambense* Versieux & Leme. —A, B. Abaxial epidermis showing the asymmetric trichomes. —C. Pollen grain. —D. Detail of the pollen grain reticulate exine. —E. Conduplicate-spiral post-anthesis stigma. —F. Globose papillae on the edges of stigma lobes. From the holotype, *L. M. Versieux 149* (HB).

narrowly triangular-lanceolate, apex acuminate-attenuate, 14–15 × 3–4 mm, connate at base for ca. 1 mm, symmetric or nearly so, glabrescent, finely nerved, erect, white, membranaceous, entire, sharply carinate; corolla erect and tubular at anthesis, petals subspatulate, apex subobtuse and inconspicuously emarginate, 30–32 × 10 mm, free, glabrous, white, bearing at base 2 sublinear-lanceolate, acuminate to irregularly bidentate appendages, 3–4 × 1 mm; stamens included, filaments 16–20 mm, terete, white, free or nearly so, anthers oblong, ca. 2 mm, base slightly sagittate, apex minutely apiculate, dorsifixed near the base; pollen grains single, ellipsoid, monocolpate, exine reticulate, ca. 60 × 22 µm; ovary obovate, trigonous, 6 × 4–5 mm, white, glabrous, epigynous tube ca. 1 mm, placentation axile; style included, white, distinctly surpassing the anthers, 28–30 mm; stigma conduplicate, weakly spiral, 2–3 mm, white, inconspicuously papillose; ovules numerous, obtuse, restricted to upper 1/3 of the ovary locule. Fruits white becoming green toward apex, fleshy, trigonous, ca. 8 × 4 mm; seeds ca. 10, elliptic to ovoid, ca. 2 × 0.8 mm, yellowish white.

Orthophytum itambense can be distinguished from the most similar taxon, *O. supthutii* in several characteristics as pointed out in the following key:

1a. Leaf blade glabrous and lustrous on the adaxial surface; sepals unequally connate at base for 2–5 mm; petals orange-yellow, petal appendages 5–7 mm long . . . . . *O. supthutii*

1b. Leaf blade with trichomes forming white cross-bands on the adaxial surface; sepals nearly free, connate at base for ca. 1 mm only; petals white, petal appendages 3–4 mm long . . . . . *O. itambense*

Orthophytum supthutii may be misidentified as *Cryptanthus schwackeanus* Mez in herbaria, although the latter can be distinguished from both *O. supthutii* and *O. itambense* by its elliptic petals connate by 2–3 mm without appendages.

Leaf anatomy has also indicated several differences that can be used to separate *Orthophytum itambense* from *O. supthutii*. First, the adaxial hypodermis of *O. itambense* has four to five layers, and the first two of these layers have thickened, lignified cell walls. The hypodermis of *O. supthutii* consists of five to six layers of cells, and only the first one has cells with thickened, lignified walls. Second, in *O. itambense* the chlorenchyma is located in the inner half of the mesophyll with seven to eight layers, and in *O. supthutii*, while it has similar chlorenchyma, there are 10 to 11 cell layers. Third, peltate trichomes in *O. itambense* have a stalk composed of three basal cells, while in *O. supthutii* it is composed of only two basal long cells. Finally, in the abaxial epidermis, stomata are projected in *O. itambense* (Fig. 2G), while they are only weakly projected in *O. supthutii* (Souza, pers. obs.).

Leme (2004a) proposed a provisional division for *Orthophytum* into two complexes and six subcomplexes of species, in which *O. supthutii* was segregated alone in subcomplex supthutii by its stemless habit,

the similar color of the inner and outer leaves at anthesis, sessile inflorescence, and by the unusual bright orange-yellow petals. In fact, *O. supthutii* has been an intriguing species mainly because of its orange-yellow petals, with no obvious, closely related taxon within the genus, and thus the basis for the Gross and Barthlott (1990) suggestion that a new subgenus be created for this species. The inclusion of *O. itambense* as the second species in this subcomplex supthutii provides new impetus for further analyses of these two unique taxa and a better understanding of their position in the genus.

Distribution, habitat, and conservation status. *Orthophytum itambense* grows on quartzite outcrops at ca. 850 m elevation and is usually associated with Eriocaulaceae, Velloziaceae, and Xyridaceae species. It grows inside gallery forest at shaded and moist spots along the margins of Rio Preto, cachoeira da Fumaça, in Pico do Itambé State Park, located at Santo Antônio do Itambé (Figs. 2A, B). Despite being under legal protection, Pico do Itambé State Park still suffers environmental aggressions such as fires from adjacent agricultural areas. These fires can reach gallery forests, especially during the dry season (winter). Land clearing is also a problem around the protected area, thus compromising the natural populations of *O. itambense* and its habitat.

Similar conservation problems affect its closest relative, *Orthophytum supthutii*, which also has a restricted distribution even within the limits of its area of occurrence at the Cipó range (Leme, 1995) about 100 km south from Santo Antônio do Itambé. According to Gross and Barthlott (1990) and Rauh and Gross (1990), *O. supthutii* grows as a lithophyte on vertical rocky walls in deciduous forests or under full sun on rocky soil at altitudes above 1000 m.

Based on the IUCN criteria (IUCN, 2001), *Orthophytum itambense* and *O. supthutii* can be given the conservation status of Critically Endangered CR B1ab(ii, iii) and Endangered EN B1ab(ii, iii), respectively, due to their restricted occurrence area, habitat loss, and small population size. This situation enforces further distribution analyses and conservation projects with these taxa.

Paratypes. BRAZIL. **Minas Gerais:** Santo Antônio do Itambé, Parque Est. do Pico do Itambé, cachoeira da Fumaça, ca. 876 m, 16 Dec. 2005, *R. B. Louzada 6, L. M. Versieux & A. M. Calvente* (SP), ca. 830 m, 10 Oct. 2006, *L. M. Versieux 302, A. M. Calvente & R. B. Louzada* (MO, SEL, SPF).

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Petrocodon ferrugineus (Gesneriaceae), a New Species from Guangxi, China

Yi-Gang Wei

The Botanical Institute of Guangxi, Academia Sinica, Guilin 541006, People's Republic of China. weiyigang@yahoo.com.cn

Abstract. A new species, *Petrocodon ferrugineus* Y. G. Wei (Gesneriaceae) from Guangxi Province in southern China, is described and illustrated. Its relationship with *Petrocodon dealbatus* Hance is discussed. The new species is distinguished by the dense villous pubescence of the leaves, bracts, and plant axes; filaments that are linear, glabrous, curved, and somewhat expanded in the middle; and fruits with 4-loculicidal, but not septicidally dehiscent, capsules.

Key words: China, *Gesneriaceae*, Guangxi, *Petrocodon*.

The genus *Petrocodon* Hance (Gesneriaceae) is comprised of one species, *P. dealbatus* Hance, with two varieties established in 1883. These plants are perennial, acaulescent herbs with caespitose habit and 5 to 15 leaves that are elliptic-obovate, elliptic to oblong, and petiolate. The inflorescences are always subumbelliform. The flowers are distinguished by two stamens and two staminodes, with a superior ovary, and the fruit is generally 2-valvular. The new species, *P. ferrugineus*, differs by having fruits with 4-loculicidal, but not septicidally dehiscent, capsules. The morphological characteristics of *P. dealbatus* and *P. ferrugineus* are compared in Table 1. *Petrocodon* is distributed in the southern provinces of Guangxi, Guangdong, Guizhou, Hunan, and Hubei. After a morphological study, study of the pertinent literature, and examination of other specimens, the authors are convinced that the morphological features of the specimens from Guangxi represent a new species.

Petrocodon ferrugineus Y. G. Wei, sp. nov. TYPE: China. Guangxi Prov.: Xincheng Co., 15 July 2004, *Yi-gang Wei & Chao Cui 0402* (holotype, IBK; isotype, PE). Figure 1.

Haec species *P. dealbato* affinis, sed foliis supra dense villosis apice obtusis raro acutis; petiolis, pedunculis, pedicellis, calycibus dense ferrugineo-pilosis; corollis campanulatis extus sparse purpureo-puberulis, filamentis curvis versus medium dilatatulis, capsulis 4-loculicidis differt.

Perennial herb, acaulescent; rhizomes terete, 1.5–4 cm, 2–10 mm diam. Leaves 8 to 15, elliptic to oblong, 3–6 × 1.8–2.5 cm, obtuse to acute at apex, cuneate at base, margin with crenation generally up to the middle, densely villous on the abaxial and adaxial surfaces, often purple abaxially, petioles 0.5–3.5 cm, with dense ferruginous villous pubescence. Inflorescence of 1 to 5 cymes, 4- to 11-flowered; peduncles 2–10 cm, with dense ferruginous pubescence; bracts 2, lanceolate to narrowly linear, 4–5 × ca. 1 mm, with dense ferruginous pubescence, slender, 4–8 mm. Calyx 5-parted to the base, calyx lobes linear, 1–2 × 0.2–0.3 mm, with dense ferruginous pubescence; corolla white, campanulate, 4–5 mm, with sparse purple-red pubescence outside, corolla tubes longer than the limbs, 3–4 mm, corolla mouth orifice 3–4 mm diam., superior corolla upper lip ca. 2 mm long, 2 corolla lobes slit to the base, these lobes deltoid; inferior lip, ca. 2 mm long, 3 lobes split close to the base, these lobes deltate to ovate; stamens 2, glabrous, filaments linear, glabrous, curved, somewhat expanded in the middle, ca. 2 mm long, inserted at about 1 mm from the base of

Table 1. Morphological characteristics of *Petrocodon ferrugineus* and *P. dealbatus*.

	P. ferrugineus	*P. dealbatus*
Leaf	apex obtuse to acute, densely villous adaxially and abaxially, often purple abaxially, petioles with dense ferruginous villous pubescence	apex acute to acuminate, sparsely pubescent adaxially and abaxially, not purple abaxially, petioles sparsely pubescent
Flower	peduncles, calyces, bracts with dense ferruginous pubescence; corolla campanulate with sparse purple-red pubescence outside, filaments curved, somewhat expanded in the middle	peduncles, calyces, bracts with pubescence; corolla urceolate with pubescence outside, filaments not curved, not expanded in the middle
Fruit	4-loculicidal, but not septicidally dehiscent capsules	capsule, 2-valvular

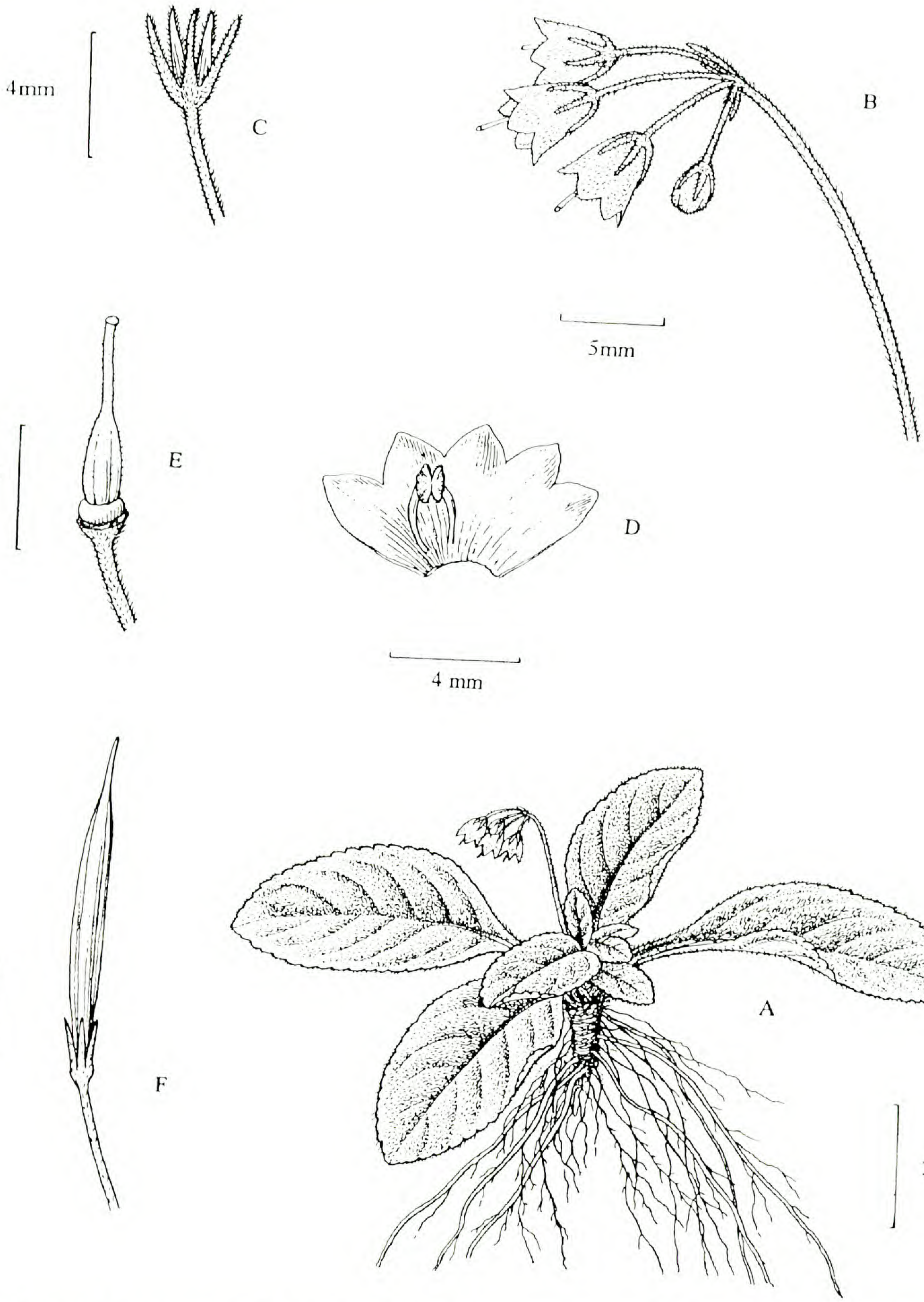

Figure 1. *Petrocodon ferruginum* Y. G. Wei. —A. Habit. —B. Inflorescence. —C. Calyx. —D. Dissected corolla. —E. Ovary and style. —F. Fruit. Drawn from the holotype *Yi-gang Wei & Chao Cui 0402* (IBK) by Shun-qing He.

the corolla; anthers coherent, confluent at their apex, anthers elliptic, ca. 1 mm; staminodes 2, linear, straight, 0.3–0.5 mm, glabrous, inserted 0.5–0.8 mm from the base of the corolla; disk ca. 0.5 mm high, annular; pistil linear, with sparse pubescence, 6–7 mm, often exserted; ovary ca. 2 mm, style ca. 4 mm. Stigma small, spheroidal. Fruit 5–20 × 1–2 mm, linear, glabrous, loculicidal, opening by 4 valves; seeds fusiform, 0.6–0.8 mm, seed coat ± glabrate.

Phenology. Flowering July–August.

Distribution. Known from limestone hills and stony slopes, under forest cover at 250 m elevation in Xincheng County, Guangxi Province, in southern China. The new species could be seen only on the

northeastern slope of the limestone hill, with a population size of approximately 100. The author considers *Petrocodon ferrugineus* to be endemic to Xincheng County.

Paratypes. CHINA. **Guangxi Prov.:** Xincheng Co., 14 July 2006, *Yi-gang Wei 06200* (IBK, MO), 23 Sep. 2003, *Yi-gang Wei & Chao Cui 0301* (IBK), 17 June 1985, *Xiu-xiang Chen & Zhi-ren Liu 61327* (GXMI).

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A New Species of *Sinojackia* (Styracaceae) from Hubei, Central China

Yao Xiao-Hong,[1] *Ye Qi-Gang*,[1] *Ge Ji-Wen*,[2] *Kang Ming*,[1] *and Huang Hong-wen*[1,*]

[1]Wuhan Botanical Garden, Chinese Academy of Sciences, Wuhan 430074, People's Republic of China.

*Corresponding author: hongwen@wbgcas.cn

[2]Faculty of Life Sciences and Technology, School of Environmental Studies, China University of Geosciences, Wuhan 430074, People's Republic of China

Abstract. *Sinojackia huangmeiensis* J. W. Ge & X. H. Yao, a new species of *Sinojackia* Hu from Hubei Province, central China, is described and illustrated. It is similar to *S. xylocarpa* Hu. The new species differs from *S. xylocarpa*, however, in its smaller flowers with broadly ovate petals and smaller fruit bearing a papillate short beak.

Key words: China, *Sinojackia*, Styracaceae.

Sinojackia Hu is a Chinese endemic genus of only seven species (including the new one described here). The first report of this genus was based on a specimen from Jiangsu Province, in eastern China, which was recognized as *S. xylocarpa* Hu (Hu, 1929). Since then, Hu (1930) described *S. rehderiana* Hu from Jiangxi, and Merrill (1937) transferred *Pterostyrax henryi* Dummer to *S. henryi* (Dummer) Merrill. Subsequently, Luo (1992) described *S. sarcocarpa* L. Q. Luo from Sichuan, and Chen discovered *S. microcarpa* C. T. Chen & G. Y. Li and *S. oblongicarpa* C. T. Chen & T. R. Cao from Zhejiang and Hunan, respectively (Chen & Li, 1997; Chen, 1998). *Sinojackia oblongicarpa* has also been treated as a synonym of *S. sarcocarpa* (Luo, 2005). During recent field surveys on the Longgan Lake Wetland Reserve located at the boundary between Hubei and Anhui Province, a new species of *Sinojackia* exhibiting distinctive morphological characters differing from other species of this genus was discovered.

Sinojackia huangmeiensis J. W. Ge & X. H. Yao, sp. nov. TYPE: China. Hubei: Huangmei County, Xiaxin, Qianlin, bushes by Longgan lake, 30 m, ca. 29°59′N, 116°01′E, 16 Apr. 2005, *X. H. Yao & C. T. Chen 05003* (holotype, PE; isotype, HIB). Figure 1.

Haec species *Sinojakiae xylocarpae* affinis, sed floribus minoribus, petalis late-ovatis 10–12 × 9–10 mm, et fructibus minoribus, cum rostro papillato brevi 16–18 mm longo, 9–12 mm diam. differt.

Trees deciduous, to 3–4 m tall; trunk thorny, to 10 cm DBH; bark vertically fissured and peeling; branches grayish brown; current year's shoots green, densely stellate-pubescent, second year's branches blackish brown, glabrous, longitudinally striate; winter buds naked, with densely dark brown stellate trichomes. Leaves simple, alternate, papery; petiole 2–3 mm; leaves at base of the flowering branch with blade ovate, other leaves with blade widely ovate to narrowly ovate, all leaves 5–12 × 2–6 cm; apex acuminate, margin serrate, secondary veins 8 to 10 per side; leaves sparsely stellate-pubescent abaxially and along veins adaxially, glabrescent. Inflorescences racemose, 4- to 6-flowered; pedicel 2–2.5 cm; sparsely stellate-puberulent, pendulous; calyx (5)6(7)-dentate; teeth triangular, 1–1.2 × 0.9–1.2 mm at base, densely stellate-pubescent; corolla white, deeply 5- to 7-parted; lobes imbricate, broadly ovate, 10–12 × 9–10 mm, apex slightly cuspidate; stamens 10 to 12, inserted at base of corolla, longer than corolla lobes; filaments erect, ca. 3.5–4 mm, sparsely stellate-pubescent; anthers oblong, connective shortly developed; ovary inferior, 3-locular, with 6 to 8 ovules per locule in 2 rows; placentation axile; style filiform, subulate, ca. 7–8 mm; stigma usually obscurely 3-lobed. Fruit ovoid including a short and papillate beak, grayish brown, 16–18 × 9–12 mm diam.; beak 3–4 mm; exocarp ca. 1 mm thick, densely lenticellate; mesocarp spongy, ca. 4 mm thick; endocarp woody; seeds 1 to 2; seed coat smooth; endosperm fleshy.

Phenology. Flowering March through April; fruit ripening October through November.

Distribution and habitat. Only known from its type locality in Hubei, the new species grows on a hillside near Longgan lake together with *Quercus serrata* Thunberg var. *trevipetiolata* Nakai, *Ilex cornuta* Lindley & Paxton, *Cephalotaxus fortunei* Hooker, *Liquidambar formosana* Hance, and *Symplocos paniculata* (Thunberg) Miquel. This habitat differs from that of other *Sinojackia*, which favor riparian habitats.

Conservation status. *Sinojackia huangmeiensis* is endemic to China and known only from a single

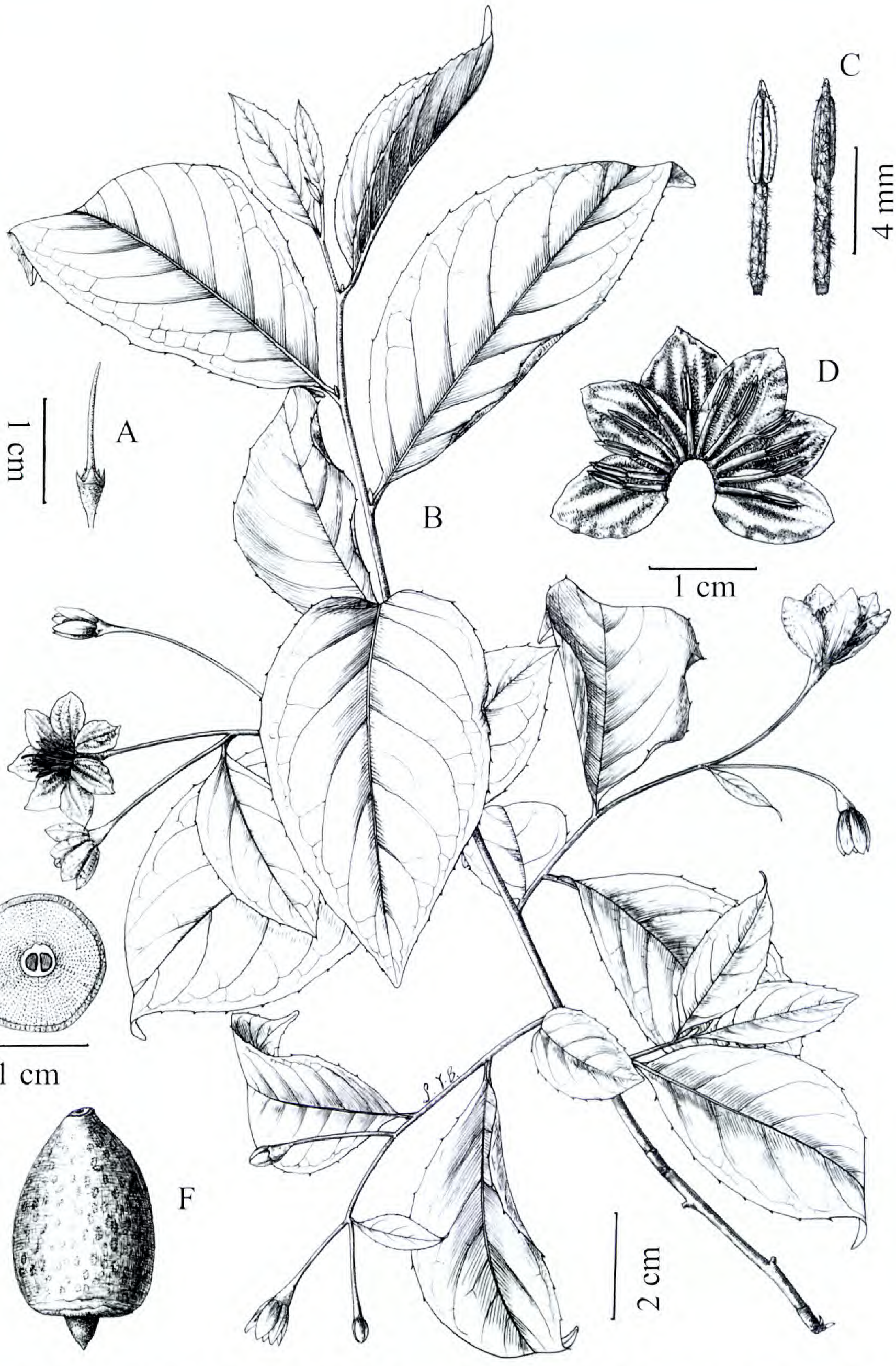

Figure 1. *Sinojackia huangmeiensis* J. W. Ge & X. H. Yao. —A. Pistil. —B. Habit. —C. Stamens. —D. Opened calyx showing androecium. —E. Cross section of fruit. —F. Fruit. Drawn from the holotype *X. H. Yao & C. T. Chen 05003* (PE).

population of about 200 individuals (including young trees). A conservation strategy should be urgently carried out to conserve this rare, or probably endangered species, although extensive field survey for additional populations of the genus is needed to clarify the taxonomic and conservation status of the whole genus.

Sinojackia huangmeiensis is similar to *S. xylocarpa* but differs from it by its smaller flowers (10–12 × 9–10 mm) with broadly ovate petals, while *S. xylocarpa* has larger flowers (12–13 × 8–10 mm) with oblong-elliptic corolla lobes, as well as by its smaller grayish brown fruits (16–18 × 9–12 mm) with a papillate short beak, while *S. xylocarpa* has larger rufous fruits (20–25 × 20–24 mm) with a long and conical beak.

Paratypes. CHINA. **Hubei:** Huangmei County, bushes by Longgan lake, alt. 30 m, 18 Aug. 2001, *J. W. Ge 200101* (CUG); alt. 30 m, 25 May 2004, *X. H. Yao 04004* (HIB).

Key to the Species of *Sinojackia*

1a. Fruits glabrous.
  2a. Fruits crimped after drying . . . . . *S. sarcocarpa*
  2b. Fruits plump after drying.
    3a. Fruits 6- to 12-ribbed when dry; mesocarps undeveloped . . . . . *S. microcarpa*
    3b. Fruits unribbed when dry; mesocarps developed.
      4a. Fruits with a papillate short beak; petals broadly ovate . . *S. huangmeiensis*
      4b. Fruits with a long and conical or acuminate apical beak; petals oblong-elliptic.
        5a. Fruits ovoid with a conical apical beak, 20–25 × 20–24 mm . . . . . *S. xylocarpa*
        5b. Fruits ellipsoid with an acuminate apical beak, 20–25 × 10–12 mm . . . . . *S. rehderiana*
1b. Fruits stellate hairy . . . . . *S. henryi*

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Two New Species of *Bomarea* (Alstroemeriaceae) from Colombia

Fernando Alzate Guarin

Posgrado de Biología, Universidad de Antioquia, Apartado Aéreo 1226, Medellín, Antioquia, Colombia. fernando_alzate@hotmail.com

Abstract. The revision of the family Alstroemeriaceae for the *Flora of Colombia* recognizes two previously undescribed species of *Bomarea* Mirbel: *B. callejasiana* Alzate and *B. colombiana* Alzate. *Bomarea callejasiana* is recognized because it has slightly hypocrateriform perianth and *B. colombiana* because of its pilose and glaucous abaxial leaf surface. Currently, both species are only known from Colombia.

Resumen. La revisión de la familia Alstroemeriaceae para la *Flora de Colombia*, permitió dar a conocer dos especies de *Bomarea* Mirbel no descritas: *B. callejasiana* Alzate y *B. colombiana* Alzate. *Bomarea callejasiana* se reconoce por tener perianto ligeramente hipocrateriforme y *B. colombiana* por sus hojas con envés piloso y glauco. Actualmente ambas especies, son solo reportadas para Colombia.

Key words: Alstroemeriaceae, *Bomarea*, Colombia, IUCN Red List.

Bomarea Mirbel (Alstroemeriaceae) was established in 1804, initially including six species segregated from the genus *Alstroemeria* L. Sanso and Xifreda (1995) later proposed *B. ovata* (Cavanilles) Mirbel as the type of the genus. Traditionally, *Bomarea* has been distinguished from *Alstroemeria* because the latter has actinomorphic and erect flowers. According to Sanso and Xifreda (2001), additional characters, such as morphology of the subterranean organs, pollen exine sculpture, and dehiscence of fruits, are useful to separate the genera.

The genus *Bomarea* is widely distributed in Colombia, particularly in middle and high Andean forest, where the taxon presents one of the largest diversities for the family (Hofreiter & Tillich, 2002). Species of *Bomarea* include climbing and erect herbs with persistent, mostly resupinate leaves, an inferior ovary, six stamens, free perianth segments, an umbellate inflorescence, and underground rhizomes.

Bomarea in Colombia comprises 35 taxa belonging to the subgenera *Bomarea* Mirbel, *Sphaerine* Pax, and *Baccata* Hofreiter, which grow in low-montane and montane forest (Alzate, pers. obs.); *Bomarea* is the most diverse subgenus, with approximately 70 to 75 species (Hofreiter, 2005), and is found between 1800–2800 m (Hofreiter & Tillich, 2002).

The recent taxonomical revision of the family Alstroemeriaceae for the *Flora of Colombia* revealed the existence of two previously undescribed species of *Bomarea*, which are described here.

Bomarea callejasiana Alzate, sp. nov. TYPE: Colombia. Nariño: Mun. Barbacoas, corr. Altaquer, vereda El Barro, reserva nat. Río Ñambi, vertiente occidental andina, bosque pluvial premontano, margen izquierda del río Ñambi, 1325 m, 11 Dec. 1993, *P. Franco, D. Giraldo, W. Beltrán, A. Prieto & O. Rivera 5147* (holotype [fl], COL; isotype [st], COL). Figure 1.

Herba sarmentosa; caule 3–5 mm, puberulente. Folia late ovata, 14–21 × 7.4–10.4 cm, glabra, discoloria. Inflorescentia composita; bracteis foliaceis, 5.6–9.5 × 0.5–4 cm, ovatis; bracteolis 2.5–3.4 × 0.4–0.7 cm, linearis ad lanceolatas; radiis puberulentibus, purpurascentibus. Segmenta perianthii inaequalia; sepalis rubris, 5–6 cm; petalis luteis, maculatis, 5.5–6.5 cm, apice 1–2 mm; ovario glabro, glabrescenteve.

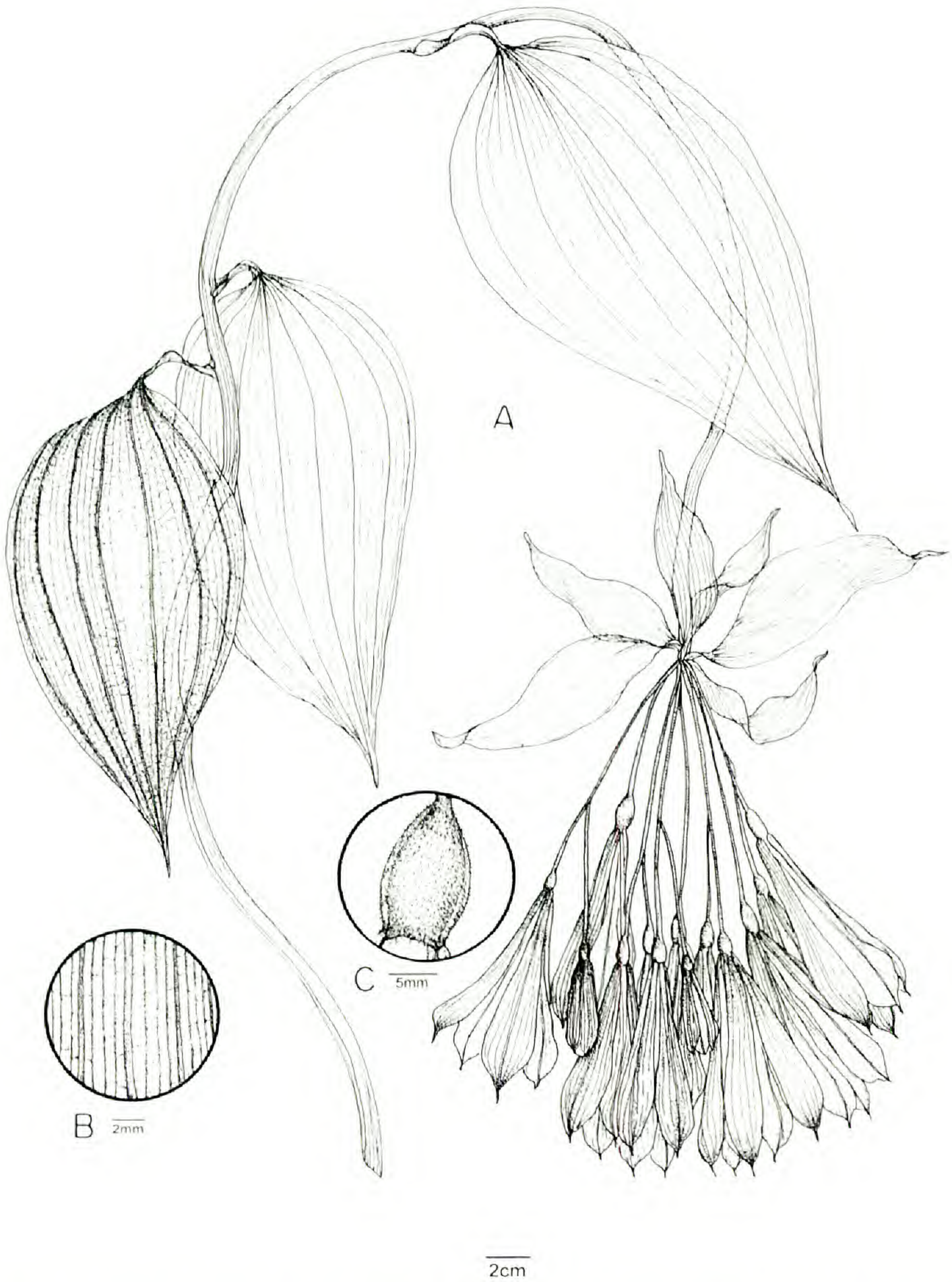

Figure 1. *Bomarea callejasiana* Alzate. —A. Habit. —B. Leaf, abaxial surface. —C. Ovary, external surface. Based on the type *P. Franco et al. 5147* (COL).

Sarmentose herb; stem 3–5 mm diam., terete, puberulent, purple; internodes 1.5–6 cm. Leaves petiolate, resupinate, petiole 17–27 mm, glabrous; leaf blade 14–21 × 7.4–10.4 cm, widely ovate, granular adaxially and glabrous, pustulate, pale abaxially, papyraceous when dry; base rounded, apex acuminate. Inflorescence compound umbel; bracts leaflike, petiolate, 5.6–9.5 × 0.5–4 cm, ovate, papyraceous when dry, base obtuse, apex acuminate, margin entire; bracteoles sessile, 2.5–3.4 × 0.4–0.7 cm, linear to lanceolate, apex acute to acuminate; rays 12 to 15, puberulent, quite purple, 7–10 cm; pedicels 3–5 cm, puberulent. Flowers 2 per fertile axis, inner perianth segments longer than the outer; outer tepals 5–6 cm, slightly hypocrateriform, ovate, glabrous to shortly puberulent, apex obtuse, 1–2 mm, red-fuchsia; inner tepals 5.5–6.5 cm, oblanceolate, glabrous, apex acuminate, unguiculate, 1–2 mm, cream with dark spots and purple costae; filaments 40–50 mm, glabrous; anthers 3–4 mm; ovary inferior, subspherical, apically constricted, glabrous to glabrescent, rugose; style 45–65 mm, glabrous. Fruit and seeds not seen.

Distribution and habitat. The new species is endemic to Colombia. *Bomarea callejasiana* has only been collected in the vicinity of the town Barbacoas, department of Nariño. This area is a premontane pluvial forest, at 1300 m, influenced by the Andean western slope and the Pacific plain, which produces high humidity at median altitudes, thus producing a unique floristic habitat. The persistence of this species depends on the conservation of this forest.

IUCN Red List category. We assess the status of this species as EN or endangered according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Bomarea callejasiana* flowers between December and January.

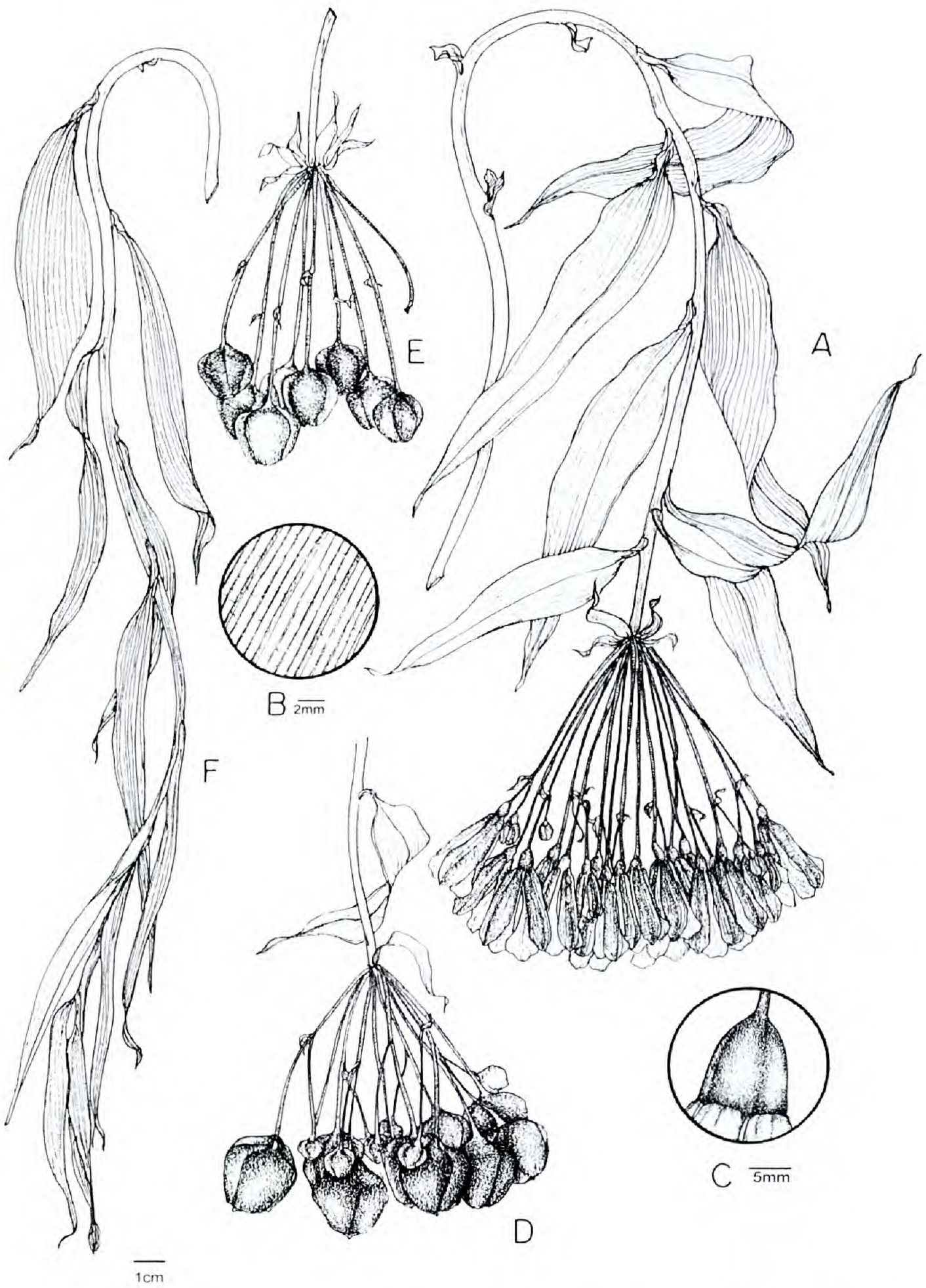

Figure 2. *Bomarea colombiana* Alzate. —A. Habit. —B. Leaf, abaxial surface. —C. Ovary, external surface. —D. Fruits developed in compound umbel. —E. Fruits in simple umbel. —F. Shoot tip with young leaves protecting apical meristems. Based on the holotype *N. de López 370* (COL) and the paratype *J. Kirkbride Jr. & E. Forero 1787* (NY).

Etymology. The species is named in honor of the Colombian botanist Ricardo Callejas Posada (HUA), specialist in the family Piperaceae.

Taxonomic relationships. *Bomarea callejasiana* is included in the subgenus *Bomarea*, section *Vitellinae* Killip (Baker, 1882; Killip, 1936), which is characterized by a compound umbel and by having perianth segments of different sizes. *Bomarea callejasiana* is distinguished by characteristics such as the hypocrateriform perianth, its leaves with a granular adaxial surface but pustulate and discolored abaxially, and the red-fuchsia color of the outer tepals.

Bomarea colombiana Alzate, sp. nov. TYPE: Colombia. Magdalena: Sierra Nevada de Santa Marta, Cerro Quemado, 2420 m, 18 July 1969, *N. de López 370* (holotype, COL). Figure 2.

Herba sarmentosa; caule 5–7 mm, glabro, glabrescente. Lamina ovata ad lanceolatam, 9–13 × 2–4 cm, inferne dense pilosa, glauca. Inflorescentia umbella simplex vel composita; bracteis foliaceis, ovatis; bracteolis lanceolatis; radiis 8 ad 15, 5–9 cm, glabris ad puberulentes. Perianthium sepalis rubris, 1.8–3 cm, petalis flavi-viridibus, purpureis maculatis, 2.4–3.2 cm; ovario glabrescente ad puberulentem.

Sarmentose herb, pendant at the apex; stem 5–7 mm diam., glabrous to glabrescent; internodes 1.8–5.5 cm. Leaves petiolate, resupinate; petiole 8–14 mm, puberulent; leaf blade 9–13 × 2–4 cm, ovate to lanceolate, glabrous adaxially, densely pilose and glaucous abaxially, chartaceous when dry, base obtuse, apex acuminate, margin revolute. Inflorescence simple or compound umbel; bracts leaflike, ovate-lanceolate, petiolate to sessile, 6–7 × 1–1.3 cm, ovate-lanceolate, pilose, pubescent or puberulent abaxially, base acute, apex acuminate; brac-

teoles sessile, 5–15 × 2–4 mm, lanceolate, adpressed, medial to the ray, pubescent abaxially, apex acute; inflorescence rays 8 to 15, 5–9 cm, glabrous to puberulent; pedicels 3–4 cm, glabrous, pubescent, or puberulent. Flowers 1 or 2 per fertile axis, inner perianth segments longer or equal sized to outer ones; outer tepals 1.8–3 cm, oblanceolate, puberulent, apex obtuse, unguiculate, 0.5–1 mm, red; inner tepals 2.4–3.2 cm, widely obovate, apex mucronate, yellow-green with purple maculae, glabrescent, costae purple with sparse trichomes; filaments 17–25 mm, glabrescent; anthers 2–3 mm; ovary inferior, turbinate, rugose, glabrescent to puberulent; style 22–29 mm, puberulent. Capsule subspherical, 1.3–2 cm diam.; seeds 2–3 mm diam., spheroid, sarcotesta red.

Distribution and habitat. This species is endemic to the Sierra Nevada de Santa Marta between 2100 and 3500 m. The highest peak in the Sierra Nevada de Santa Marta is 5700 m, which emerges from a coastal plain as an island that has been isolated for about 3 million years (van der Hammen, 1974). This isolation has had marked effects on the colonization pattern and speciation of the existing vegetation, which also includes *Bomarea moritsiana* Klotzsch ex Kunth, *B. patinii* Baker, and *B. edulis* (Tussac) Herbert.

IUCN Red List category. We assess the status of this species as EN or endangered according to IUCN Red List criteria (IUCN, 2001).

Phenology. Collected in flower and fruit during the months of January, February, July, September, and October.

Etymology. The specific epithet refers to Colombia, where it is endemic.

Taxonomic relationships. Subgenus *Bomarea* is a group characterized by a compound umbel and sarmentose habit. The species complex includes *B. colombiana*, *B. moritsiana*, *B. longipes* Kränzlin, *B. caucana* Alzate, and *B. hazenii* Killip; all species have foliar pubescence and a similar biogeographical distribution. *Bomarea colombiana* differs from the remaining species of the group by its abaxially glaucous leaves and the apical meristems protected by numerous juvenile leaves with the appearance of large bracts.

Paratypes. COLOMBIA. **Magdalena:** Sierra Nevada de Santa Marta, cabecera del río Sevilla, *H. Barclay 6566* (COL, MO); SE slopes Sierra Nevada de Santa Marta, hoya del río Donachuí, *J. Cuatrecasas & R. Romero 24690* (COL); SE forested slopes from Cancurúa to Sogrome, *J. Cuatrecasas & R. Romero 24829* (COL); Subparamos, *J. Cuatrecasas & R. Romero 24678* (COL), *J. Kirkbride Jr. & E. Forero 1787* (COL, NY).

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Cousinia aligudarzensis (Asteraceae), a New Species of Section *Cynaroides* Bunge from Iran

Farideh Attar and Ahmad Ghahreman
Central Herbarium, Department of Botany, Faculty of Science, Tehran University, Tehran, Iran.
fattar@khayam.ut.ac.ir

ABSTRACT. *Cousinia aligudarzensis* Attar & Ghahreman (Asteraceae), a new species of section *Cynaroides* Bunge (as "*Cynaroideae*") is described and illustrated. The distinguishing characters of section *Cynaroides* and those separating the new species from its nearest relative are discussed.

Key words: Asteraceae, *Cousinia*, Iran, section *Cynaroides*.

The genus *Cousinia* Cassini (Asteraceae) includes over 670 species in 53 sections distributed primarily in the arid areas of the Irano-Turanian region (Attar, 2000). It is represented in Iran by some 240 species (190 endemic) and is the second largest Iranian genus after *Astragalus* L. (Ghahreman & Attar, 1999). Several new species have recently been described from Iran (Attar & Ghahreman, 2000, 2002; Attar et al., 2000, 2001a, b, 2002; Ghahreman et al., 1999; Mehregan et al., 2003), and we believe that the genus has been inadequately surveyed for the Irano-Turanian region. Most species of *Cousinia* have a highly restricted distribution, and numerous taxa are known only from the type collection or from a limited number of gatherings.

The new species described below, *Cousinia aligudarzensis* Attar & Ghahreman, was discovered by the authors in 2001 during fieldwork in Luristan Province in Iran. It was found in a small patch or small community and can therefore be potentially identified as endangered.

Cousinia aligudarzensis Attar & Ghahreman, sp. nov. TYPE: Iran. Luristan: 10 km on rd. to Khomeyn City from 3-way intersection at Aligudarz, ca. 1500 m, 21 July 2001, *F. Attar & A. Ghahreman 27613* (holotype, TUH; isotype, TUH). Figure 1.

Herba biennis pluricaulis, omnino appressa araneoso-tomentosa, canescens; caulis usque 30 cm altus, dense foliatus, incomplete spinoso-alatus, alis cuneato-attenuatis. Folia coriacea, sessilia, pinnatifida vel lobata, lobis triangularibus in spinam terminalem tenuem usque ad 3 mm longam excurrentia. Capitulae usque ad 5.5 cm diam., 120 ad 150-florae; phyllaria patentia, 70 ad 75, coriacea, appendiculata; phyllaria exteriora 16.5–22 mm longa, appendice 10–14 × 7–9 mm, triangularia, reflexa, margine multispinosa; phyllaria intermedia 24–29 mm longa, appendice 7–17 × 5–9 mm, triangularia, lateraliter utrinque spinis 2 brevioribus praedita; phyllaria interiora 25–27 mm longa, appendice 4–6 × 2.5–4.5 mm, rhombica, apice in spinam erectam excurrente; phyllaria intima straminea, prominentia, lanceolata, sensim-attenuata. Corolla rosea, ca. 22 mm longa, laciniis 3–4 mm longis. Achenia ca. 5 × 2 mm, obpyramidalia, longitudinaliter striata, rugosa, exteriora curvata, interiora recta.

Biennial, multistemmed herb, totally appressed arachnoid tomentose, canescent, rarely glabrescent and green; stems up to 30 cm tall, few branched, densely leafy, incompletely winged; wings spiny, cuneate-attenuate. Leaves ca. 15 × 4 cm, coriaceous, sessile, pinnatifid or lobed; lobes triangular, terminating into a spine ca. 3 mm; venation pinnate-reticulate, prominent on both surfaces; basal leaves lanceolate, pinnatifid, 10–30 cm; cauline leaves cuneate at the base, reduced gradually upward. Heads terminal, solitary, to 5.5 cm diam., 120- to 150-flowered; phyllaries spreading, 70 to 75, coriaceous, constricted distally, appendiculate; outer phyllaries 16.5–22 mm, with an appendage 10–14 × 7–9 mm, triangular, with numerous spines on each side, reflexed; median phyllaries 24–29 mm, with an appendage 7–17 × 5–9 mm, triangular, with 2 small spines on each side, spreading to erect; inner phyllaries 25–27 mm, with an appendage 4–6 × 2.5–4.5 mm, rhomboid, terminating to a straight spine; innermost phyllaries stramineous, acute, prominent, lanceolate, gradually attenuate; receptacle bristles smooth, rarely indistinctly scabridulate, longer than the cypselae. Corolla pink, brown when dry, ca. 22 mm, tube about as long as the limb, lobes 3–4 mm; anther tube purple, glabrous. Achenes ca. 5 × 2 mm, obpyramidal, attenuate toward base, blackish brown, longitudinally striate, pallid-maculate, rugose, denticulate above, outer ones curved, inner ones straight; pappus scabrous, caducous.

Cousinia aligudarzensis is most closely related to *C. lactiflora* Rechinger f. The new species is readily

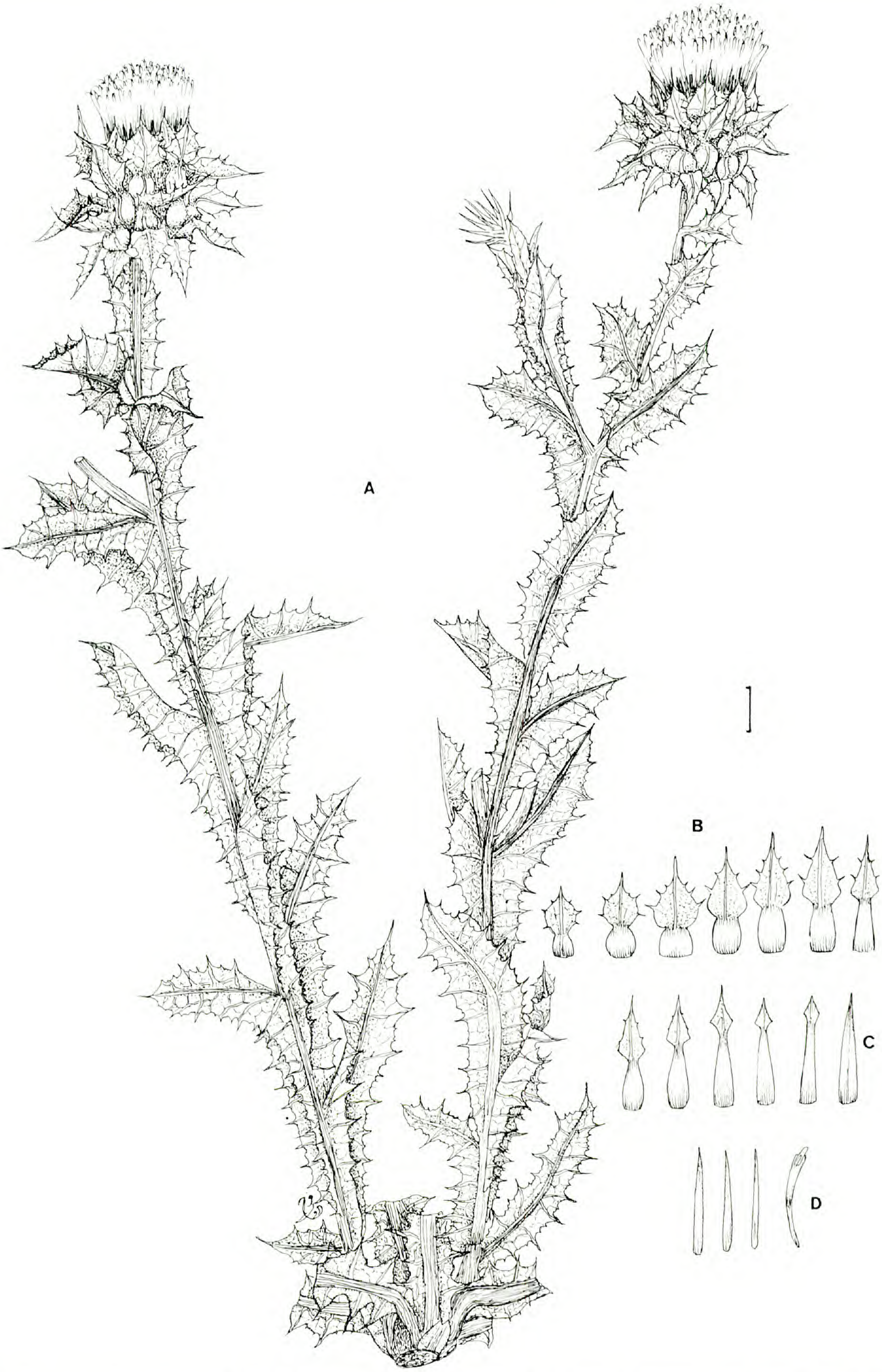

Figure 1. *Cousinia aligudarzensis* Attar & Ghahreman. —A. Plant. —B. Outer phyllaries. —C. Median phyllaries. —D. Inner phyllaries. Scale: A, not drawn to scale; B–D = 1 cm. Drawn from the holotype *Attar & Ghahreman 27613* (TUH).

distinguished by having heads with 120 to 150 (instead of 80 to 100) flowers, a specified taxonomic character in *Cousinia*; pink instead of creamy white corollas; prominent instead of less prominent inner bracts; and pink-purple instead of milky white anther tubes.

Section *Cynaroides* Bunge (as "*Cynaroideae*") differs from the remaining 62 sections of *Cousinia* (Rechinger,

1972, 1979) by having appendiculate bracts. The section *Cynaroides* includes about 90 species in *Cousinia*, of which about 75 species grow in Iran; about 60 of these are endemic (Attar, 2000). The vast majority of the species grow in the Zagros and Elburz mountains, two ranges that represent the centers of the greatest diversity of this section. A comprehensive synopsis of section *Cynaroides* is in progress and will soon be submitted for publication.

Paratype. IRAN. **Luristan:** 10 km on rd. to Khomeyn City from 3-way intersection at Aligudarz, ca. 1500 m, 16 June 2002, *Attar & Ghahreman 25000A* (TUH).

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A New Species of *Asplenium* (Aspleniaceae, Pteridophyta) from Ethiopia

Peter Chaerle and Ronald Viane

Ghent University, Department of Biology, Research Group Pteridology, K. L. Ledeganckstraat 35, B-9000 Gent, Belgium. peter.chaerle@ugent.be; ronnie.viane@ugent.be

Abstract. A new species of *Asplenium* L. from Ethiopia, *A. balense* Chaerle & Viane, is described and illustrated. This new species is similar to *A. demerkense* Hieronymus, which differs in rhizome, scales, and frond morphology, and also in the presence of short false veins in the laminae. The new species resembles *A. uhligii* Hieronymus, but differs in degree of lamina dissection and in the presence of unicellular capitate glands on the indusial margin. *Asplenium balense* also resembles *A. erythraeum* Pichi Sermolli, which can be distinguished by the absence of both glands and false veins. *Asplenium balense* belongs to the group of East African high-altitude (2000–4700 m) *Asplenium* species similar in gross morphology to members of the *A. aethiopicum* (Burman f.) Becherer complex. A key to distinguish *A. balense* from its three most similar, tropical northeast African species (*A. demerkense*, *A. erythraeum*, and *A. uhligii*) is presented.

Key words: Aspleniaceae, *Asplenium*, East Africa, Ethiopia, IUCN Red List.

In species numbers and distribution, *Asplenium* L. (Aspleniaceae) is one of the richest fern genera, represented worldwide by a total of ca. 720 species (Kramer & Viane, 1990). Unlike other pteridophyte taxa for which reviews have been published in the *Adumbratio Florae Aethiopicae* (Pichi Sermolli, 1954, 1956, 1957, 1962, 1963a, b, 1965, 1966, 1968, 1969a, b, 1978; Bizzarri, 1975), the tropical northeast African Aspleniaceae have not been revised. The new species described here belongs to the group of East African high-altitude (2000–4700 m) spleenworts with thin, long-creeping rhizomes and widely spaced fronds with long stipes and finely dissected blades. Typical members of this group are: *A. actiniopteroides* Peter, *A. decompositum* Peter, *A. demerkense* Hieronymus, *A. goetzei* Hieronymus, *A. kassneri* Hieronymus, *A. majus* (Hieronymus) Pichi Sermolli, *A. mildbraedii* Hieronymus, *A. praegracile* Rosenstock, *A. uhligii* Hieronymus, and *A. volkensii* Hieronymus, and to a lesser extent *A. aethiopicum* s.l., *A. lademannianum* Rosenstock, *A. linckii* Kuhn, *A. simii* A. F. Braithwaite & Schelpe, and *A. stipicellatum* Pichi Sermolli. These species are all very similar to each other and have a variable gross morphology, which reaches its extreme in the widespread and polymorphic *A. aethiopicum* complex. This macromorphological similarity and variability, together with the lack of micromorphological and cytological data, has led to misidentifications of herbarium material and to a general underrepresentation in floristic publications (e.g., Hedberg, 1957; Faden, 1974; Schippers, 1993). East African high-montane *Asplenium* species were treated in Cei and Pichi Sermolli (1940), Cufodontis (1952, 1969), Schelpe (1953, 1970), Hedberg (1957, 1971), Tardieu-Blot (1958), Pichi Sermolli (1964, 1977, 1985), Faden (1974), Friis et al. (1982), Schelpe and Anthony (1986), Jacobson and Jacobson (1989), Burrows (1990), Schippers (1993), Thulin (1993), Friis and Vollesen (1998), Roux (2001), and Chaerle and Viane (2002).

Material and Methods

Specimens deposited in the herbaria of BR, EA, GENT, UPS, and in the personal herbaria of R. Pichi Sermolli and the second author have been studied. Exospore measurements were carried out on untreated spores mounted in DePeX (Gurr, BDH Laboratory, Poole, United Kingdom) (sample size $n = 60$ per specimen) using the equipment and program described by Viane (1990). Stomatal length (sample size $n = 60$ per specimen) was determined on pinnules treated as described in Viane (1990) and measured with the same method as for the spores. False veins (Chaerle & Viane, 2004) and indusial (Reichstein et al., 1994; Rasbach et al., 1994) and indument characteristics (Rasbach et al., 1994; Viane, 1985a, b, 1986) of unicellular capitate glands, hairs, paleasters, and paleae of the abaxial epidermis were studied on the treated pinnules. Rhizome paleae and stipe base scales mounted in Euparal were digitized and measured using Scion Image for Windows (Scion Corporation, Frederick, Maryland). Total scale length and width at the widest part and the length of the "apical tail" (the terminal part, consisting of two rows of cells of which only the common anticlinal cell walls are thickened) were measured. Photos were taken with an Olympus C-3040 Zoom digital camera (Olympus Optical Co., Ltd., Tokyo, Japan) attached to a Zeiss Axioplan2 (Zeiss, Oberkochen, Germany) microscope

equipped with an Axiophot2 module. Stereomicroscopic photos were captured with a Nikon DXM1200 digital camera attached to a Nikon SMZ800 stereomicroscope (Nikon Corporation, Melville, NY). Fronds were scanned with a flatbed scanner. Meiotic chromosome numbers were obtained using the acetocarmine squash technique of Heitz (1925) and Manton (1950). For scanning electron microscopy (SEM), spores were coated with gold to a thickness of 35–40 nm. The samples were observed with a scanning electron microscope JEOL JSM-5600LV at 15 kV. All images were transferred to Adobe Photoshop, where they were processed into plates. Means and standard deviations (*s*) were calculated over all vouchers; measurements given in the description are given in the following format: (minimum) mean minus *s*–mean plus *s* (maximum), e.g., (30)34–39(45).

Results and Discussion

Asplenium balense Chaerle & Viane, sp. nov. TYPE: Ethiopia. Bale prov.: Goba–Dola Mena rd. (over Mt. Batu), Sanetti Plateau, 21 km S of Goba, 3870 m, 16 Jan. 1998, *R. L. L. Viane 7141* (holotype, GENT; isotypes, pers. herb. R. Viane). Figure 1A–D, Figure 2.

Plantae epiphyticae vel epilithicae. Ab *Asplenio demerkensi* Hieronymus rhizomatibus gracilibus, cellulis parietibus externis palearum hyalinis vel dilutis flavis; foliis minoribus, laminis angustis ovatis ad lanceolatis, basi pinnato-pinnatisectis; nervis falsis ex sinibus ad juncturam nervorum verorum; exosporiis minoribus (37 ± 2.5 μm longitudo medianis) differt. Ab *A. uhligii* Hieronymus laminis minus dissectis, indusiis marginibus pilis glanduliferis differt. Plantae tetraploideae, meiosi 72 bivalentibus.

Plants epiphytic or epilithic; rhizomes to 4 mm diam., green when living, long-creeping, sparsely branching, scaly; rhizome scales (3.2)4.3–6.5(7.8) × (0.8)1.0–1.4(1.6) mm wide at their base, lanceolate to narrowly lanceolate, base cordate, margin entire, apex acuminate, ending in a long apical tail (0.2)0.5–1.2(1.6) mm; anticlinal cell walls dark brown, periclinal cell walls colorless to light yellow. Fronds ca. (135)183–286(316) mm; stipes generally longer than laminae, to 170 × 2 mm wide at the base, terete, green when young but proximally and abaxially brown when mature, on both lateral sides a green respiratory line, adaxially green and sulcate; glandular; bases densely covered with paleae (2.6)4.0–6.9(8.6) × (0.7)0.9–1.5(2.0) mm wide at their base, ending in a long apical tail (0.5)0.7–1.4(1.7) mm, similar to those on the rhizomes, toward the rachis more sparsely paleaceous with similar but smaller scales; rachis structure similar to that of distal part of stipe. Laminae (70)76–125(147) × (27)28–42(48) mm, narrowly ovate to lanceolate, pinnate-pinnatisect at the base, becoming pinnate-pinnatifid to pinnate toward the apex; pinnae 5 to 10 pairs, second pair usually the longest, (18)20–29(31) × (7)8–12(14) mm; basal pinnae petiolate but gradually sessile distally, narrowly ovate to rhomboid, pinnatisect, unequally cuneate, acroscopic segment larger and less adnate than the basiscopic segment, apex attenuate; ultimate segments cuneate to linear, margins with narrow-linear teeth; laminae densely glandular on abaxial and adaxial surfaces, sparsely scaly; false veins present and running from the sinus to junction of the 2 neighboring true veins; stomata anomocytic and (basi- to crypto)polocytic; guard cells (41)50–60(72) μm long. Sori linear; indusia transparent and set with unicellular capitate glands on their margins. Spores plano-convex with exospore (30)34–39(45) μm long, perispore costate with venate outer perispore. Plants tetraploid (4 ×) with 72 bivalents during meiosis ($n = 72^{II}$).

Etymology. Named after the Bale mountains, where it was discovered by the authors.

Asplenium balense is morphologically very similar to *A. demerkense* and *A. uhligii*. Our study of type material of *A. demerkense* (*Schimper 243*) present in B (Fig. 1E) and in the personal herbarium of Pichi Sermolli showed that this is generally a larger fern (to 45 cm) with oblong to linear-oblong, less dissected laminae (pinnate-pinnatifid at the base, pinnatisect distally), and thicker rhizomes (up to 6 mm). The cells of the scales of *A. demerkense* have dark yellow to orange periclinal walls, whereas in *A. balense* these walls are light yellow to colorless. Both *A. balense* and *A. demerkense* have unicellular capitate glands on their indusial margin and false veins. However, the long false veins in *A. balense* extend from the marginal sinuses to the junction of two true veins, while the short false veins of *A. demerkense* merely extend halfway between the sinuses and this junction (Chaerle & Viane, 2004). *Asplenium demerkense* has significantly larger spores (mean exospore length of holotype (*Schimper 243*, B): 50 ± 3.0 μm) than *A. balense* (mean exospore length: 37 ± 2.5 μm).

Asplenium uhligii has slightly more dissected laminae (pinnate-pinnatisect to 2-pinnate, Fig. 1F), lacks the unicellular capitate glands on the indusial margins, and is octoploid. Because Pichi Sermolli (1977) mentioned the superficial resemblance of *A. demerkense* to *A. erythraeum* Pichi Sermolli, we studied type material (*Pappi 1224*) of the latter in his herbarium (Fig. 1G). We found that *A. erythraeum* can easily be distinguished from *A. balense*, *A. demerkense*, and *A. uhligii* by lacking glands and false veins.

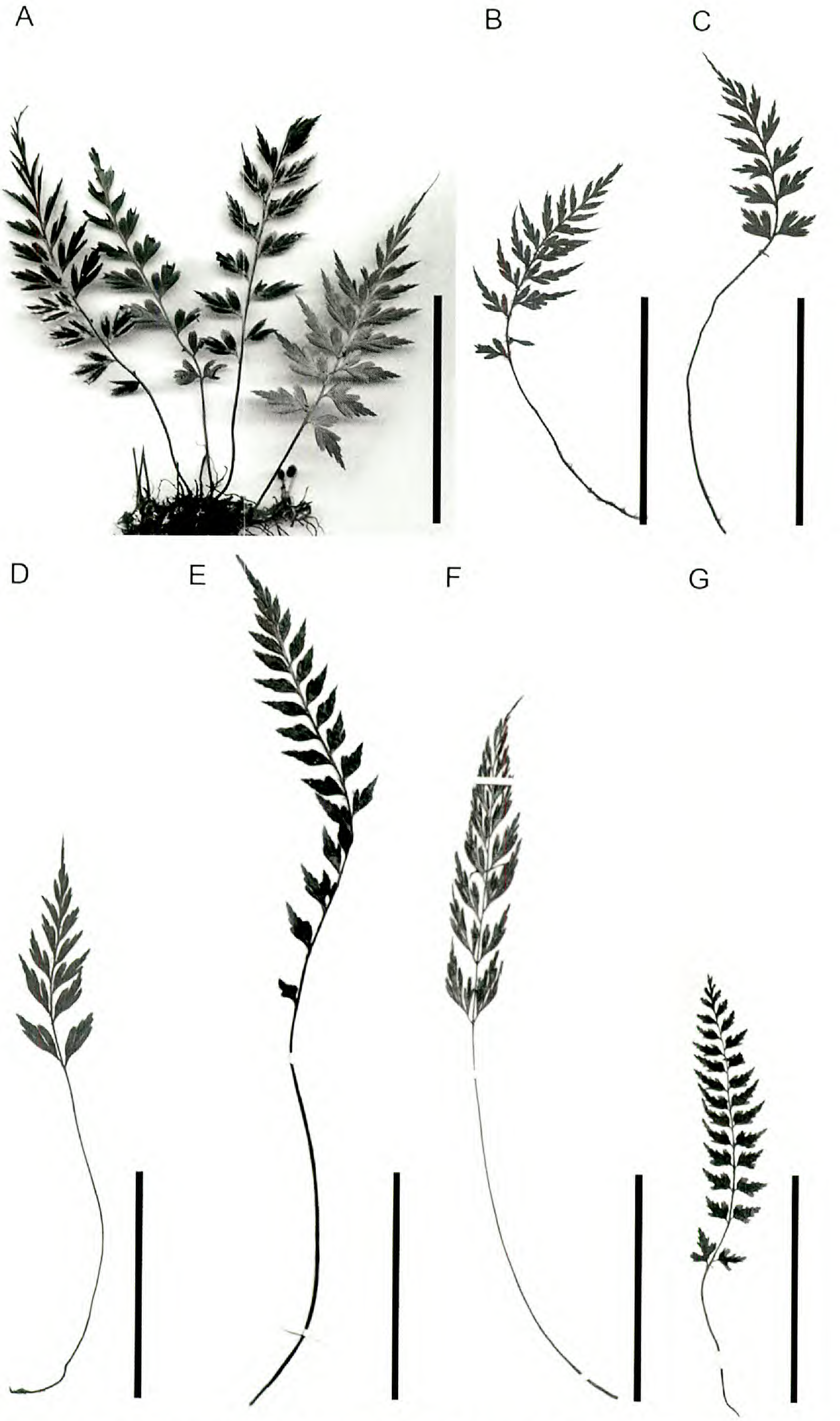

Figure 1. A–D. Variation in frond morphology of *Asplenium balense* Chaerle & Viane. Note the significantly shorter stipe in the cultivated material. —A. Habit of living plant (*Viane 7141*) cultivated in Ghent Botanical Garden. —B. Frond of *Viane 7164* (pers. herb. R. Viane, paratype, wild collection). —C. Frond of *Viane 7142* (pers. herb. R. Viane, paratype, wild collection). —D. Frond of *Viane 7141* (pers. herb. R. Viane, isotype, wild collection). E–G. Comparison of fronds of three northeastern African species most similar to *A. balense*. —E. *A. demerkense* (*Schimper 243*, B, holotype). —F. *A. uhligii* (*Uhlig 194*, B, syntype). —G. *A. erythraeum* (*Pappi 1224*, herb. Pichi Sermolli, isotype). Scale bar = 10 cm.

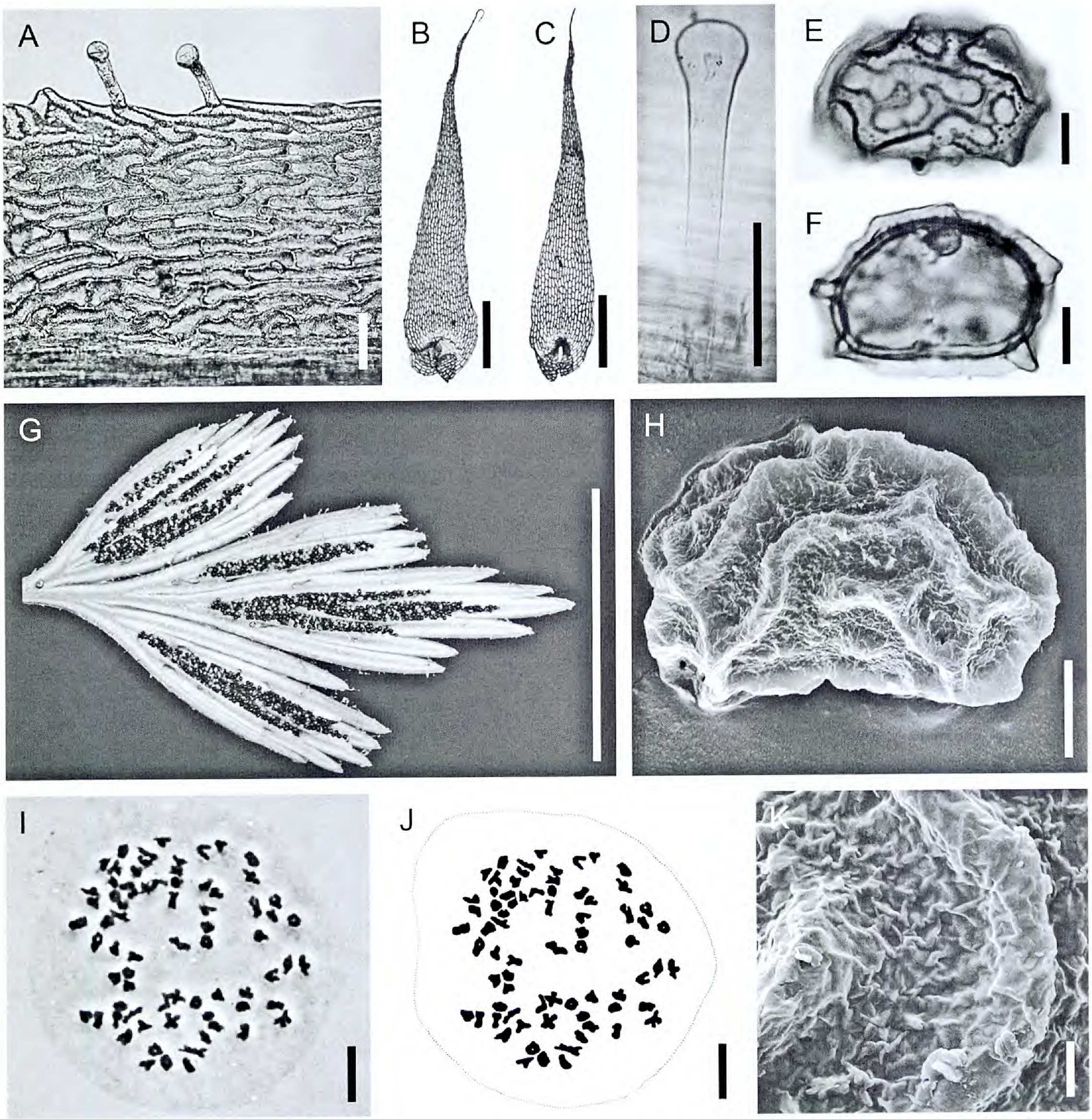

Figure 2. Micromorphology and cytology of *Asplenium balense* Chaerle & Viane. —A. Part of indusium (*Viane 7141*, pers. herb. R. Viane, isotype) from its base along a vein (bottom) to its margin set with unicellular capitate glands (top). —B. Rhizome scale (*Viane 7142*, pers. herb. R. Viane, paratype). —C. Stipe base scale (*Viane 7142*, pers. herb. R. Viane, paratype). —D. Unicellular capitate gland (*Viane 7142*, pers. herb. R. Viane, paratype). —E. Spore showing perisporal folds (*Viane 7164*, pers. herb. R. Viane, paratype). —F. Optical section of spore showing exospore contour (*Viane 7164*, pers. herb. R. Viane, paratype). —G. Abaxial side of fertile pinna (*Viane 7141*, cultivated), false veins visible as dark lines starting in the sinuses and ending near the junction of true veins. H, K. SEM micrographs of spore (*Viane 7141*, pers. herb. R. Viane, isotype). —H. Equatorial view. —K. Detail of costate fold with venate micropattern. I, J. Spore mother cell (*Viane 7159*, pers. herb. R. Viane, paratype) in metaphase I showing $n = 72^{II}$. —I. Photograph. —J. Explanatory diagram. Scale bar: A, D = 100 µm; B, C = 1 mm; E, F, H, I, J = 10 µm; G = 1 cm; K = 2 µm.

Habitat and distribution. *Asplenium balense* is at present known only from the Arsi and Bale provinces in Ethiopia, where it is an epiphytic or epilithic species of the upper ericaceous and/or lower Afroalpine belts between 3150 and 3870 m elevation.

IUCN Red List category. *Asplenium balense* may be considered an IUCN category VU B1 taxon (IUCN, 2001), because its geographic range is estimated to be less than 20,000 km^2 and its range is severely fragmented and limited to fewer than 10 locations

showing a continuing decline in the quality of their habitat.

Asplenium balense and the three similar tropical northeastern African species can be distinguished by the following key:

1a. Laminae with glands and false veins.
  2a. Laminae pinnate to pinnate-pinnatisect; indusial margins with unicellular capitate glands.
    3a. Rhizomes up to 6 mm diam.; laminae pinnate to pinnate-pinnatifid; false veins short; mean exospore length more than 45 µm . . . . . *A. demerkense*
    3b. Rhizomes up to 4 mm diam.; laminae pinnate-pinnatisect; false veins long; mean exospore length less than 45 µm . . *A. balense*
  2b. Laminae pinnate-pinnatisect to 2-pinnate; indusial margin without glands . . . . . *A. uhligii*
1b. Laminae without glands and false veins . . . . . *A. erythraeum*

Paratypes were previously identified as *Asplenium actiniopteroides* (*O. Hedberg 4174*, EA, UPS), *A. demerkense* (*R. Viane 7142, 7164, 7159*, GENT, pers. herb. R. Viane), or *A. uhligii* (*J. J. F. E. De Wilde 7344*, BR). Other collections deposited in herbaria under these names may represent our new taxon.

Paratypes. ETHIOPIA. **Arsi province:** Galama Mtns. (ca. 30 km ESE of Asella), ca. 3 km E of Boraluco below a small rock precipice, 6 Sep. 1967, *O. Hedberg 4174* (EA, UPS); Mt. Kaka, E slope, June 1980, *O. Hedberg & M. Tadesse 7109* (UPS). **Bale province:** Goba–Dola Mena rd. (over Mt. Batu), Sanetti Plateau, 21 km S of Goba, on rocks along road, 16 Jan. 1998, *R. Viane 7142* (GENT, pers. herb. R. Viane), 17 Jan. 1998, *R. Viane 7164* (GENT, pers. herb. R. Viane); Goba–Dola Mena rd. (over Mt. Batu), Harena escarpment, 52 km S of Goba, epiphyte in elfin forest, 16 Jan. 1998, *R. Viane 7159* (GENT, pers. herb. R. Viane); 27 km W of Dinshu, along road to Adaba, in shade on rock wall in open grassy slopes, 10 Jan. 1971, *J. J. F. E. De Wilde 7344* (BR).

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Validation of the Name *Strobilanthes sarcorrhiza* (Acanthaceae)

Deng Yunfei

Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, Yunnan, 650204, People's Republic of China; South China Botanical Garden, Chinese Academy of Sciences, Guangzhou, Guangdong, 510650, People's Republic of China; The Graduate School of Chinese Academy of Sciences, Beijing, 100049, People's Republic of China. yfdeng@scib.ac.cn

Xia Nianhe

South China Botanical Garden, Chinese Academy of Sciences, Guangzhou, 510650, People's Republic of China. nhxia@scib.ac.cn

Abstract. The name *Strobilanthes sarcorrhiza* (C. Ling) C. Z. Zheng (Acanthaceae) was not validly published in 1993 because the reference to the basionym was not cited fully. The name is validated here and represents a new combination referred from *Championella* Bremekamp. The taxon is similar to *S. oligantha* Miquel, but it differs in its rhizome thickened (vs. not thickened), petioles 0–0.3 cm (vs. 3–4 cm), leaf blades lanceolate to oblong-lanceolate (vs. broad-ovate to elliptic), lateral veins 7 to 9 (vs. 3 to 6), and spikes 2–4(−5) cm (vs. ca. 1 cm).

Key words: Acanthaceae, *Championella*, *Strobilanthes*.

Strobilanthes Blume is the second largest genus in the family Acanthaceae; it is distributed in tropical and subtropical regions of Asia. Estimates of the species number in *Strobilanthes* range from 250 species (Hu, 2002; Carine & Scotland, 2002) to 350 (Mabberley, 1987) or 450 or more (Terao, 1983). Bremekamp (1944) divided *Strobilanthes* and related genera into over 54 genera in 27 informal groups in his monograph of the subtribe Strobilanthinae Lindau. Terao (1983) recognized a broadly circumscribed *Strobilanthes* comprising all species of Strobilanthinae. The results of recent molecular studies (Moylan et al., 2004), statistical analysis (Carine & Scotland, 2002), and pollen and gross morphology (Terao, 1983; Wood, 1994, 1995) demonstrate clearly that adequate diagnosis of the majority of groups into which the Strobilanthinae was divided by Bremekamp (1944) and others (Hu, 2002; Cui, 1990; Hsieh & Huang, 1974) is problematic and that a single monophyletic expanded *Strobilanthes* should be recognized.

In the course of revising Chinese *Strobilanthes* Blume s.l., we differ from the authors of *Flora Reipublicae Popularis Sinicae* (Hu, 2002) in regarding the Strobilanthinae sensu Bremekamp (1944) as a single genus, *Strobilanthes*.

Strobilanthes sarcorrhiza (C. Ling) C. Z. Zheng (Zheng, 1993), originally described in *Championella* as *C. sarcorrhiza* C. Ling (1975), is accepted by us. However, the name *Strobilanthes sarcorrhiza* is not validly published under Article 33.3 of the *International Code of Botanical Nomenclature* (Greuter et al., 2000) because Zheng failed to fully cite the references to its basionym. The current paper validates the name by fully citing the basionym reference (Ling, 1975).

Strobilanthes sarcorrhiza is endemic to China and occurs in southwestern Zhejiang Province. The species belongs to the *Championella* Bremekamp group. This group is characterized by its mostly weak, decumbent isophyllous herbs, few-flowered and terminal spikes usually covered in prominent and large-celled white hairs, the bracts persistent and foliose, the calyx subequally 5-lobed to the base, and four fertile stamens. Bremekamp (1944) recognized this group as a distinct genus, *Championella*, consisting of nine species (Deng et al., 2006), and then Terao (1983) treated it as subsection *Championella* (Bremekamp) Terao in his unpublished system. *Strobilanthes sarcorrhiza* is similar to *S. oligantha* Miquel, but it differs in its rhizome thickened (vs. not thickened), petioles 0–0.3 cm (vs. 3–4 cm), leaf blades lanceolate to oblong-lanceolate (vs. broad-ovate to elliptic), lateral veins 7 to 9 (vs. 3 to 6), and spikes 2–4(−5) cm (vs. ca. 1 cm).

Strobilanthes sarcorrhiza (C. Ling) C. Z. Zheng ex Y. F. Deng & N. H. Xia, comb. nov. Basionym: *Championella sarcorrhiza* C. Ling, Acta Phytotax. Sin. 13(3): 93. 1975. TYPE: China. Zhejiang Province, *C. Ling (71)037* (holotype, PE).

Additional specimens examined. CHINA. **Zhejiang:** Linhai xian, Kuocangshan, 1000 m, *Ding Bingyang & Jin Weishan 83* (HZU); Wenling xian, Meixi gongshe, Gingkun-

shan, *Hangzhou Bot. Gard. Hb. 4129* (PE); Yongjia xian, Huangnan xiang, Zhukeng, *Hong Lin 2160* (HZU); Yueqing xian, Yandangshan, 10 Oct. 1915, s. coll. *945* (PE); Yueqing xian, Yandangshan, Linyansi, *C. Ling 731505* (PE); Yueqing xian, Beiyandangshan, *Zhang Chaofang & Zheng Chaozhong 5898* (HZU); Yueqing xian, Yandangshan, Guzhudong, *Zhang Chaofang & Zheng Chaozhong 6203* (HZU); Yueqing xian, Yandangshan linchang, *Ding Bingyang & Zhang Qingmian 1857* (HZU); s. loc., *Wang Kehui s.n.* (IBSC).

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New Species of *Sphaeradenia* (Cyclanthaceae) from Costa Rica and Ecuador

Roger Eriksson

Department of Plant and Environmental Sciences, Göteborg University, Box 461, SE 405 30 Göteborg, Sweden. roger.eriksson@dpes.gu.se

Abstract. Two new species of *Sphaeradenia* Harling (Cyclanthaceae), *S. rostellata* R. Eriksson from Costa Rica and *S. marcescens* R. Eriksson from Ecuador, are described and illustrated. *Sphaeradenia rostellata* is distinguished from the closely related *S. praetermissa* R. Eriksson and *S. occidentalis* R. Eriksson by the widely separated, uncinate stigmas. *Sphaeradenia marcescens* differs from the supposedly closely related *S. pallida* R. Eriksson by the persisting staminate flowers.

Resumen. Se describen e ilustran dos especies nuevas de *Sphaeradenia* Harling (Cyclanthaceae), *S. rostellata* R. Eriksson de Costa Rica y *S. marcescens* R. Eriksson de Ecuador. *Sphaeradenia rostellata* se distingue de las especies estrechamente relacionadas, *S. praetermissa* R. Eriksson y *S. occidentalis* R. Eriksson, por los estigmas muy separados y uncinados. *Sphaeradenia marcescens* se diferencia de la especie probablemente más relacionada, *S. pallida* R. Eriksson, por las flores estaminadas persistentes.

Key words: Costa Rica, Cyclanthaceae, Ecuador, *Sphaeradenia*.

The genus *Sphaeradenia* Harling (Cyclanthaceae) is characterized by, e.g., distichous leaves, pistillate flowers with one apical placenta, and anthers often having an apical secretion globule. Furthermore, the fruiting spadices are often brightly colored, in contrast to many other cyclanths. It is distributed from southern Nicaragua to northern Bolivia, extending eastward into Venezuela and adjacent Brazil, and is commonly found in humid habitats from sea level up to ca. 3000 m altitude, or in some areas even higher. *Sphaeradenia* was recently revised (Eriksson, 1995), with 50 recognized species of which 20 were described then as new. There are obviously new *Sphaeradenia* species to be discovered, and two of them are described here.

Measurements were taken on dried material according to Eriksson (1995: fig. 1), except that median and lateral floral structures were not separately measured. Floral and fruiting structures, and to some extent vegetative parts, may shrink considerably during drying.

Sphaeradenia rostellata R. Eriksson, sp. nov. TYPE: Costa Rica. Limón: Cantón de Talamanca, Cordillera de Talamanca, Cerro El Codo, betw. Ujarrás & San José Cabécar, 9°21′23″N, 83°13′40″W, 1500 m, 19 Mar. 1993, *A. Fernández 741* (holotype, INB; isotype, CR not seen). Figure 1A–C.

Planta epiphytica vel terrestris. Laminae 76–81 cm longae, segmentis 10–11 cm latis, lanceolatis, costa 24–28 cm longa; petiolus 40 ad plus quam 85 cm longus; vagina 33–51 cm longa. Spadix cylindrica vel anguste ellipsoidea, in statu fructifero rubra, in statu florifero circiter 1.5 cm diametro, in statu fructifero juveni 4.5 cm longa, 1.8 cm diametro, in statu fructifero maturo 6.3 cm longa, 2.4 cm diametro. Flores masculi caduci, 3.7–4 mm longi; antherae 0.6–0.8 mm longae, 0.5 mm latae, globis secretionis usque ad 0.05 mm diametro. Flores feminei et fructus 2.8–7 mm longi, 2.7–4.1 mm lati; tepala libera; stylus 2.5–7 mm longus; stigmata 1.9–2.8 mm longa, 0.4–0.5 mm lata, inter apices distales 3.8–6.6 mm, stigmata desuper visa linearia, uncinata, apice stricto vel deorsum curvo, a latere compressa et aliformia, in statu fructifero late separata, nonnihil inferiora ad altiora quam tepala. Semina oblonga vel anguste ellipsoidea.

Epiphyte or terrestrial plant. Leaf blades 76–81 cm, bifid 68%–65% of their length, segments 10–11 cm broad, lanceolate, acuminate, ridge distance 12–15 mm, abaxial ridges with low papillae (sometimes almost smooth), midrib 24–28 cm; petiole 40 to more than 85 cm; sheath 33–51 cm. Peduncle 21–31 cm, straight; spathes 3, white tinged with red, longest one 11 cm. Spadix cylindrical to narrowly ellipsoid, in fruit red, at anthesis ca. 1.5 cm broad, in young fruit 4.5 × 1.8 cm, in mature fruit 6.3 × 2.4 cm. Staminate flowers caducous, 3.7–4 mm, pedicel 2.9–3.1 mm, receptacle 2.1–2.2 mm broad, ± flat; perianth lobes 11 to 12, including 5 to 6 adaxial ones, up to 1.1 × 0.6 mm; stamens 13 to 22, anthers 0.6–0.8 × 0.5 mm, secretion globules pale, to 0.05 mm diam., filaments 0.2–0.3 mm, basal bulbs 0.3 × 0.3 mm, ± globose. Pistillate flowers and fruits 2.8–7 × 2.7–4.1 mm; tepals 2.8–5.8 mm, 1.5–3 mm broad, 0.8–1 mm thick, free, oblong to narrowly triangular, ± acute, apex ± straight, upper part of tepals incurved at anthesis, bent outward in fruit, margins straight to incurved; style 2.5–7 × 1–

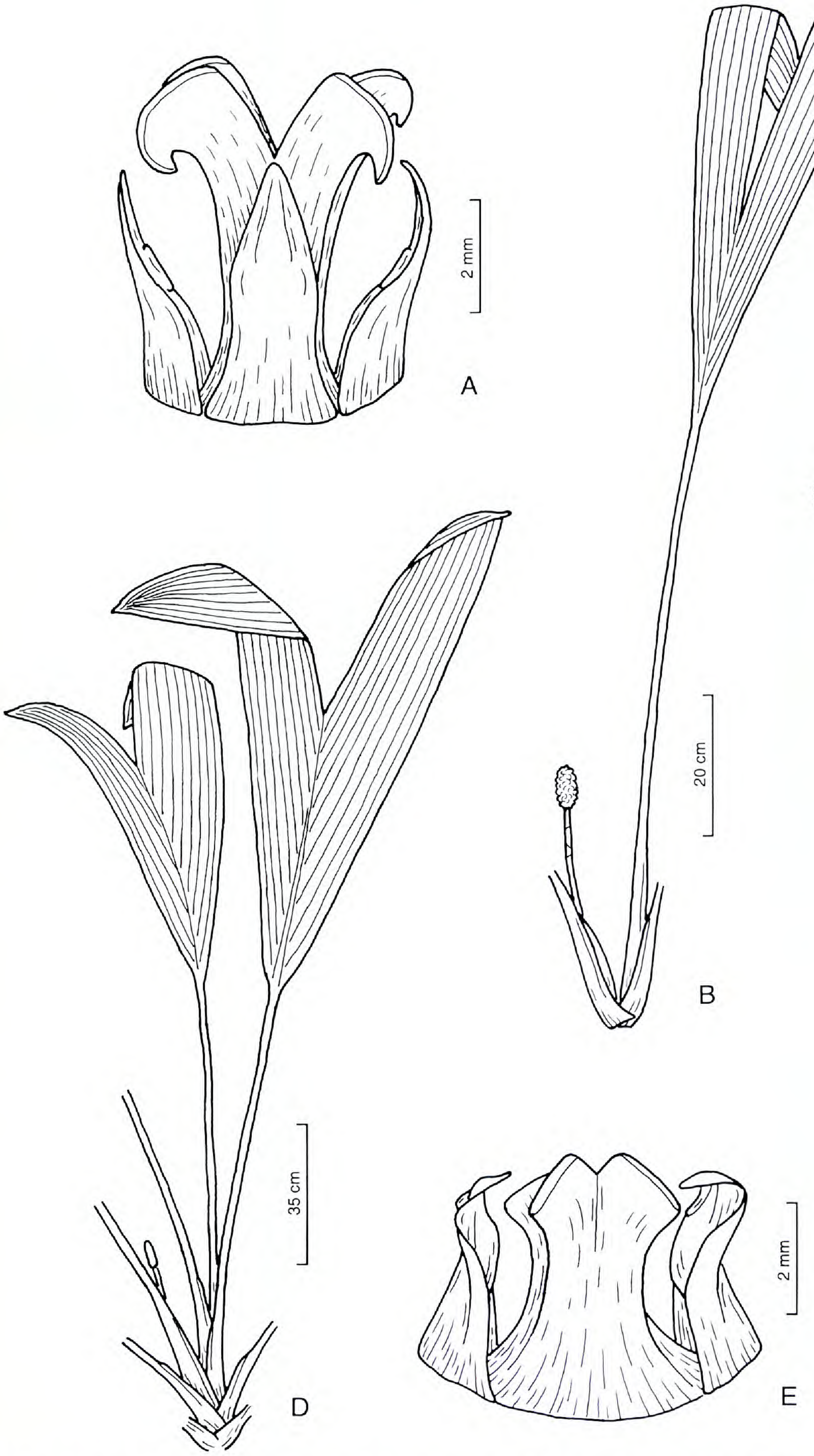

Figure 1. A–C. *Sphaeradenia rostellata* R. Eriksson. —A. Fruit (*Fernández 741*, holotype). —B. Habit (*Fernández 741*, holotype). —C. Staminate flower (*Fernández 970*). D–F. *S. marcescens* R. Eriksson. —D. Habit (*Cornejo et al. 5183*). —E. Fruit, one tepal removed (*Cornejo & Bonifaz 5107*, holotype). —F. Staminate flower (*Cornejo et al. 5183*). A–C and E–F drawn from herbarium material, D drawn from photo of live individual.

2.5 mm, columnar, in upper part developed as stigmatic arms; stigmas 1.9–2.8 × 0.4–0.5 mm, width between distal apices 3.8–6.6 mm, stigmas free, linear seen from above, distinctly uncinate, apex straight at anthesis, bent downward in fruit, style and sterile part of stigmas developed as laterally compressed stigmatic arms, stigmas ± widely separated in fruit, somewhat lower than the tepals to slightly surpassing them. Seeds 1.3 × 0.5 mm (probably immature), oblong to narrowly ellipsoid.

Distribution. This new species is known from a small area on the Atlantic slopes of the Cordillera de Talamanca in eastern Costa Rica (Fig. 2), where it has been collected in montane rainforest and cloud forest at 1500–2250 m altitude.

Discussion. *Sphaeradenia rostellata* is closely related to the Costa Rican species *S. praetermissa* R. Eriksson and *S. occidentalis* R. Eriksson but is easily distinguished from them by its distinctly uncinate, linear stigmas that are widely separated by stigmatic arms. The specific epithet alludes to this characteristic feature.

The paratype specimen *Ocampo 3510* was available and suspected to belong to a new species already when preparing the revision of *Sphaeradenia* (Eriksson, 1995), but it was badly preserved and instead cited as uncertain. Since then, additional collections have confirmed the suspicion and provided sufficient material for describing this species as new. This species was treated as *Sphaeradenia* sp. A by Hammel (2003).

Paratypes. COSTA RICA. **Limón:** Cordillera de Talamanca, Quebrada Kuisa, *J. Bittner 1788* (CR not seen, GB, INB not seen, MO not seen); Cordillera de Talamanca, Cerro Carguicacha, betw. Ujarrás & San José Cabécar, *A. Fernández 970* (CR not seen, INB); Cordillera de Talamanca, betw. Río Lori & Río Coén, *R. Ocampo 3510* (CR).

Sphaeradenia marcescens R. Eriksson, sp. nov. TYPE: Ecuador. Guayas: Reserva Ecol. Manglares Churute, Cerro Pancho Diablo, 2°25′S, 79°39′W, 500 m, 3 May 1996, *X. Cornejo & C. Bonifaz 5107* (holotype, GB). Figure 1D–F.

Planta terrestris vel epiphytica. Laminae 95–114 cm longae, segmentis 12–19 cm latis, lanceolatis, costa 36–50 cm longa; petiolus plus quam 50 cm longus; vagina plus quam 35 cm longa. Spadix cylindrica, in statu fructifero rubella, in statu florifero 4.1 cm longa, 1.3 cm diametro, in statu fructifero maturo 6.8 cm longa, 1.6 cm diametro. Flores masculi persistentes, 4–4.1 mm longi; antherae 0.6–0.7 mm longae, 0.4–0.5 mm latae, globis secretionis usque ad 0.1 mm diametro. Flores feminei et fructus 2.7–4.5 mm longi, 2.7–7.4 mm lati; tepala libera; stylus 2.3–4.5 mm longus; stigmata 1.5–2.1 mm longa, 0.4–0.6 mm lata, inter

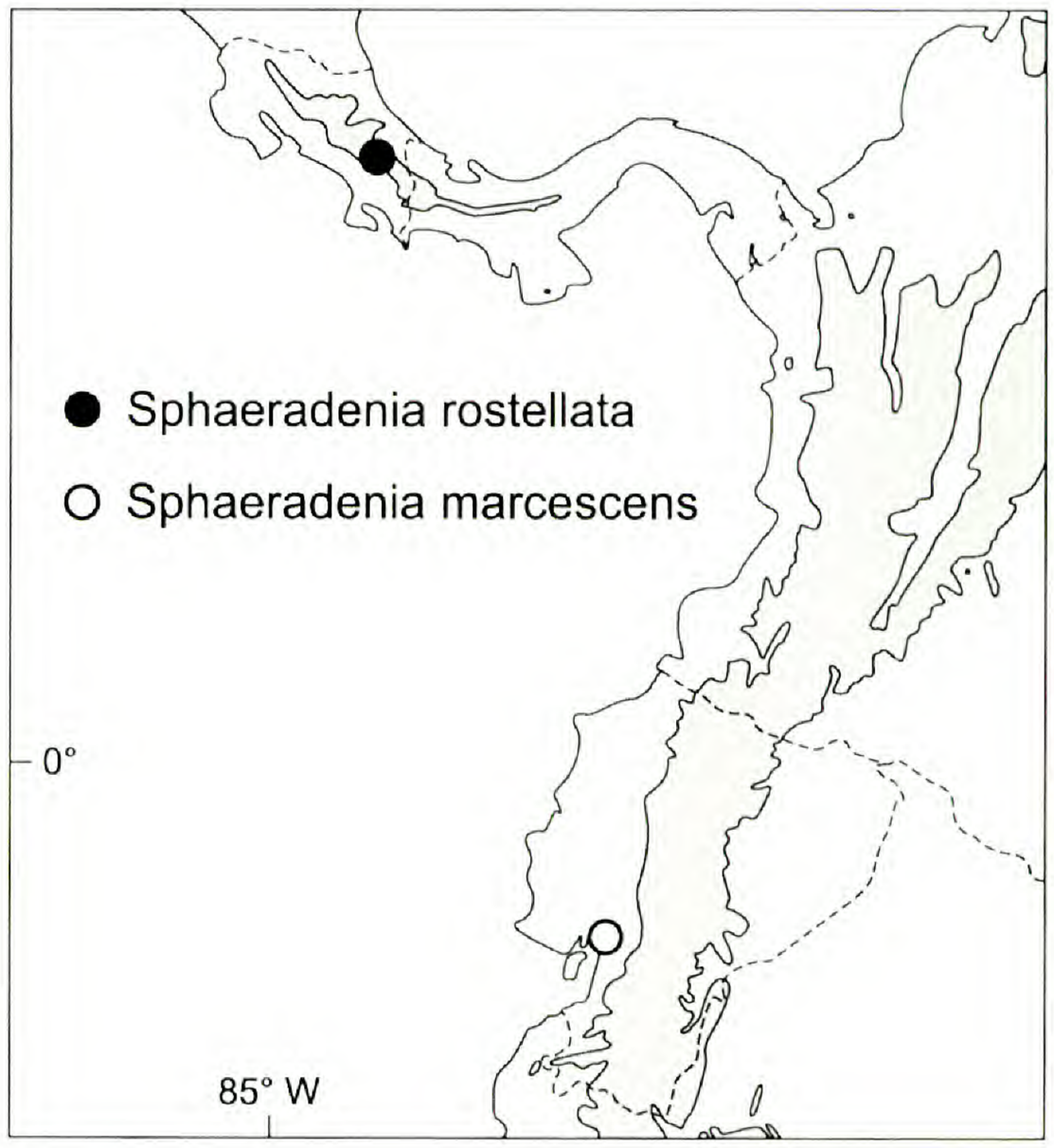

Figure 2. Distribution of *Sphaeradenia rostellata* R. Eriksson and *S. marcescens* R. Eriksson.

apices distales 3–4.2 mm, stigmata desuper visa linearia (vel anguste lanceolata), ± aliformia, pariter alta vel altiora quam tepala. Semina ellipsoidea.

Terrestrial plant or epiphyte, probably short-stemmed. Leaf blades 95–114 cm, bifid 62%–57% of their length, segments 12–19 cm broad, ± lanceolate, acuminate, ridge distance 17–21 mm, abaxial ridges smooth or with low papillae, midrib 36–50 cm; petiole more than 50 cm; sheath more than 35 cm. Peduncle 23–35 cm, straight; spathes 3, white tinged with pink, longest one 4.7–12 cm. Spadix cylindrical, in fruit reddish, at anthesis 4.1 × 1.3 cm, in mature fruit 6.8 × 1.6 cm. Staminate flowers persisting as wilted in fruit, 4–4.1 mm, pedicel 3.1–3.2 mm, receptacle 2.1–2.3 mm broad, flat to shallowly concave; perianth lobes 10 to 12, including 4 to 6 adaxial ones, up to 1 × 0.8 mm; stamens 18 to 28, anthers 0.6–0.7 × 0.4–0.5 mm, secretion globules to 0.1 mm diam., filaments to 0.2 mm, basal bulbs 0.2–0.3 × 0.2–0.3 mm, globose to slightly elongate. Pistillate flowers and fruits 2.7–4.5 × 2.7–7.4 mm; tepals 2.7–3.7 mm, 1.6–5.2 mm broad, 0.7–1.2 mm thick, free, spathulate or oblong to ± triangular, with elongate staminodial protuberance in fruit, ± acute, apex incurved, with small or without apical glandule, upper margins ± excurved, lower margins straight to incurved; staminodes ca. 5 cm, white; style 2.3–4.5 × 1–6.3 mm, columnar, in upper(most) part developed as short stigmatic arms; stigmas 1.5–2.1 × 0.4–0.6 mm, width between distal apices 3–4.2 mm, stigmas free, linear (to narrowly lanceolate) seen from above, acute, not uncinate to slightly so,

equaling tepals in height to slightly surpassing them. Seeds to 2.6 × 1.2 mm, ellipsoid.

Distribution. This new species is known only from the type locality at 500–700 m altitude in southwestern Ecuador, a humid, premontane forest (Fig. 2).

Discussion. *Sphaeradenia marcescens* is recognized by its reddish infructescences with persisting staminate flowers, the latter feature being rather uncommon in *Sphaeradenia*. The specific epithet refers to these staminate flowers. It seems to be closely related to *S. pallida* R. Eriksson from Colombia, as judged from the fruit morphology and stout habit, a species that is also found at rather low altitudes on the western slopes of the Andes.

Paratype. ECUADOR. **Guayas:** Reserva Ecol. Churute, Cerro Pancho Diablo, *X. Cornejo, C. Cornejo & C. Bonifaz 5183* (GB).

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New Species of *Tricarpelema* (Commelinaceae) from Africa and Asia, Including the First Record of the Genus from Africa and a Synopsis of the Genus

Robert B. Faden

Department of Botany, MRC-166, National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, Washington, D.C. 20013-7012, U.S.A. fadenr@si.edu

Abstract. *Tricarpelema africanum* Faden is described from Central Africa, representing the first African species of this otherwise Asian genus. The species is so distinct that *Tricarpelema* J. K. Morton subgen. *Keatingia* Faden is described for it, based mainly on its unusual vegetative morphology. *Tricarpelema brevipedicellatum* Faden is described from two Vietnamese collections that were previously treated as *Aneilema montanum* (Wight) Wallich ex C. B. Clarke or *Dictyospermum montanum* Wight. It differs from all other continental Asian species by its one-seeded locules. A key to all eight named *Tricarpelema* species is provided, along with a synopsis of the species, including full taxonomy and synonymy. *Pollia subumbellata* C. B. Clarke var. *glabra* Hallier f. is a new synonym for *T. philippense* (Panigrahi) Faden. The following names are lectotypified: *T. giganteum* (Hasskarl) H. Hara, *T. philippense* (Panigrahi) Faden, and *Pollia subumbellata* C. B. Clarke var. *glabra* Hallier f.

Key words: Africa, Commelinaceae, inselberg, *Tricarpelema*, Vietnam.

The genus *Tricarpelema* J. K. Morton was described by Morton (1966) for a single Himalayan species of Commelinaceae that did not fit within his circumscriptions of *Aneilema* R. Brown or *Dictyospermum* Wight. Hong (1974, 1981) added two new, closely related species from China to the genus. Faden (1975), in an unpublished Ph.D. thesis, emended the delimitation of *Tricarpelema* and treated it as a subgenus of *Dictyospermum*, but he did not publish these changes. Rao (1980) transferred the second Indian species to *Tricarpelema*. Faden (1991) recognized *Tricarpelema* as a distinct genus and transferred a species from the Philippines and Borneo to it. A sixth species, endemic to Borneo, was transferred to *Tricarpelema* in Cowley and Faden (1996). In the most recent account of the genus, Faden (1998) recognized a total of seven Asian species of *Tricarpelema*, with possibly an eighth, undescribed species in Central Africa. The generic status of the African species remained in doubt. It is described below as *T. africanum* Faden. One of the Asian species of *Tricarpelema*, from Vietnam, was also undescribed. It is described herein as *T. brevipedicellatum* Faden.

New Species of *Tricarpelema* J. K. Morton

Tricarpelema africanum Faden, sp. nov. TYPE: Cameroon. South Province: Ntem Department, Ebolowa Arrondissement, Village of Meyos, 2°48′N, 11°13′E, alt. ca. 750 m, growing on rocky cliffs in full sunlight, 27 Oct. 1990, *Bill* [William F.] *Keating BK90–23* (holotype, US sheet 1 [US#3216404]; isotypes, K, MO, P, US sheet 2 [US#3216405], YA). Figure 1.

Herba perennis internodiis vaginis imbricatis vestitis. Folia distichia lamina sessili moderate succulenta glanduloso-pubescenti. Inflorescentia thyrsus laxus plerumque complexus, 5–25(−30) × 4–10(−16) cm, axibus sparse glanduloso-pubescentibus. Flores androecio staminum trium posticorum brevius stamine medio antheram plerumque carentem et staminum trium anticorum subaequalis longius composito. Capsulae stipitatae aequaliter trivalvares triloculares loculis 3–5-seminalibus. Semina uniseriata.

Decumbent perennial rooting at the lower nodes; roots thin, fibrous; internodes ± covered by overlapping leaf sheaths, except distally on the flowering shoot, 2.8–6 cm, the basal ones glabrous, the distal ones sparsely glandular-pubescent. Leaves all distichous, or sometimes spirally arranged distally on the flowering shoot, only slightly reduced distally on the flowering shoots, persistent on the old stems, sheaths (0.4–)1–2 cm, glandular-pubescent, ciliate at the apex with similar hairs; lamina sessile, strongly conduplicate when dry, moderately succulent, narrowly lanceolate to linear-lanceolate or lanceolate-oblong, broadest at the base, 4–11.5 × 1–1.5 cm, apex acuminate, base rounded, amplexicaul, both surfaces sparsely glandular-pubescent, the adaxial surface more densely so than the abaxial; margins somewhat revolute (at least in dried specimens), scabrid with prickle-hairs (terminology of Tomlinson, 1966), also sparsely ciliate basally with glandular hairs. Inflorescence a pedunculate, terminal and sometimes

Figure 1. *Tricarpelema africanum* Faden. —A. Habit. —B. Cincinnus. —C. Bisexual flower, front view. —D. Bisexual flower, lateral view. —E. Posterior stamen. —F. Anterior stamen. —G. Capsule, lateral view, front sepal removed. —H. Terminal seed, dorsal view. —I. Terminal seed, ventral view. —J. Medial seed, dorsal view. —K. Medial seed, ventral view. All from *R. B. Faden 2005/002*, grown from seed of *Parmentier & Esono 3586* and cultivated at the Smithsonian Institution Botany Research Greenhouse. Drawings by Alice Tangerini.

axillary, lax compound (or rarely simple) thyrse consisting of a true terminal thyrse with up to 7 alternate (rarely 2 opposite or 3 whorled), elongate, ascending cincinni, closely associated with 1 to 6 reduced thyrses (each consisting of 2 or more cincinni) axillary from bracts between the distalmost foliage leaf and the terminal thyrse; often similar compound thyrses also produced from the axils of the distal foliage leaves on the flowering shoots; peduncle (distalmost foliage leaf to the basalmost bract of the compound thyrse) 5.5–12(–18.5) cm, compound thyrses 5–25(–30) × 4–10(–16) cm, axes all sparsely glandular-puberulous; bracts on the main axis (cincinnus bracts + bracts on the peduncle) spaced 0.8–1.5(–5 between the basalmost ones) cm apart, lanceolate to ovate, mostly 2.5–5.5 mm, shortly perfoliate, glabrous; cincinni up to 9 cm and 25-flowered, cincinnus peduncles 0.5–2.3 cm; bracteoles spaced 1–3.5(–5) mm apart, persistent (except in old infructescences), scarious, ± amplexicaul, not perfoliate, ovate, 1–1.2(–2) mm, glabrous. Flowers bisexual and male, 7–9 mm wide; pedicels 2.3–5 mm long in flower, 3.5–6(–8) mm long in fruit, erect in fruit, sparsely covered with patent, glandular hairs or occasionally glabrous; sepals free, subequal, boat-shaped, hooded and apparently glandular at the apex, oblong-elliptic, 2.5–4.1 × 1–2 mm in flower, to ca. 5 mm long in fruit, sparsely covered with uniseriate, glandular hairs, green tinged with purple; petals free, not clawed, subequal or the anterior one slightly differentiated, strongly reflexed in flower, glabrous, concolorous, pale violet, purple, rose, lilac to pink, mauve, blue or white, the inner, posterior (paired) petals narrowly elliptic to elliptic, lanceolate-ovate, ovate-elliptic or ovate, 3–6 × 1.2–4 mm, apex obtuse to rounded, base cuneate; the outer, anterior petal ovate-elliptic to ovate, elliptic or broadly elliptic, 3–6 × 1.5–3 mm, apex obtuse to rounded, base cuneate; androecium composed of 6 stamens, 1-sided, with 3 posterior, shorter stamens attached in front of the outer sepal and inner petals, and 3 anterior, longer stamens attached in front of the inner sepals and outer petal; filaments all free, slender, glabrous; posterior stamens with filaments 1–3 mm, the medial posterior stamen with filament often a little longer or shorter than the 2 laterals, commonly lacking an anther, lateral posterior stamens always with an anther, anthers dorsifixed, obdeltate to obovate, fleshy, yellow, 0.75–0.80(–1.2) × (0.55–)0.80–1.10(–1.45) mm, connective broad, obdeltate to obcordate, with 2 small basal lobes, pollen sacs distal, well differentiated from the connective, polliniferous, dehiscence latrorse, pollen yellow; anterior 3 stamens equal or subequal, filaments divergent, sometimes recurved distally, 2–5 mm, anthers dorsifixed, broadly elliptic to ovate, ± maroon (with blackish maroon sutures), 0.8–1 × 0.6–1 mm, connective narrow, pollen sac dehiscence introrse, pollen white; gynoecium ± equaling the anterior stamens in length, ovary sessile or substipitate, trilocular, trigonous, oblong-elliptic, 0.8–1.5 mm, tapered into the style, glabrous, ovules 4 or 5 per locule, uniseriate or slightly biseriate; style slender, tapering and slightly recurved distally, 1.7–4 mm, tinged with violet, glabrous; stigma ± not enlarged, maroon. Capsules equally trilocular, trivalved, oblong-ellipsoid, shortly stipitate, the valves erect (not reflexed), ± equaling the persistent sepals, 3.5–6 × 2–3 mm, light brown or greenish brown, sometimes with small, dark brown flecks, glabrous, apex obtuse to truncate (the style base not persistent), cells of the outer capsule wall transversely elongate, not conspicuous. Seeds 3 to 5 per locule (or by abortion fewer), uniseriate, exarillate; terminal seeds ovate, ca. 1.25 mm, medial seeds rectangular to trapezoidal 0.75–0.80 × 1–1.1 mm; testa gray-brown, pitted with intersecting pits and continuous and interrupted ridges; hilum linear, shorter than the seed; embryotega lateral, white.

Distribution. Southeastern Cameroon, Continental Equatorial Guinea, and northern Gabon.

Habitat and phenology. Inselbergs in the forest zone, in full sun in shallow soil, rocky slabs and cliffs, fringes of taller vegetation, less often in thickets or shady, moist situations; 500–950 m; flowering in January, March, May, June, October, and November. Flowering in the morning.

Conservation status. Because of its limited distribution and very specialized habitat, this species is vulnerable. Stephan Porembski informs me that there is increasing degradation of inselbergs, leading to habitat conversion and the introduction of exotic weeds, and that near towns and villages the human impact is severe.

The compound inflorescence may resemble a large, simple inflorescence and be composed of a small terminal thyrse and up to six secondary inflorescences from as many nodes below the terminal inflorescence, with which they all blend together (e.g., *Parmentier & Esono 3586*), or else a terminal inflorescence, with well-developed secondary inflorescences borne below but somewhat separated from it (e.g., *Keating 90–12*). The small bracts from which the secondary inflorescences arise more closely resemble the cincinnus bracts of the terminal thyrse than foliage leaves, which further makes the compound inflorescence look like a simple inflorescence. A simple terminal thyrse has been observed only in some inflorescences of *Jacques-Felix 5100* (P).

In cultivation some flowers have been observed with short styles. When examined from liquid-preserved material, such flowers also have a reduced ovary that lacks mature ovules. Such flowers are functionally male. A short-styled flower was noted in the field in the extensive notes on *Keating BK90–12*. However, it is unknown whether this flower was male.

The flowers of *Tricarpelema africanum* are very variable in size and color. The full range of flower sizes has been collected in the field by Keating, so the large flowers observed in cultivation are not an artifact. The apparent variability in flower color, based on collectors' notes, could partly be the result of people's different customs and experience in describing hue, but from the descriptions alone, this species seems to show more variation than most Commelinaceae species. The strongly reflexed petals observed in cultivation, which may make the flowers appear very narrow in front view, have not been reported in the field.

The anther of the medial posterior stamen is often lacking, although the filament may be the same length as or even longer than those of the lateral posterior stamens. This has been observed in many flowers of cultivated plants of *Faden 2005/002*, originally from Equatorial Guinea, and in flowers of *Keating BK90–11*, *Keating BK90–12*, and *Keating BK90–23*, all from Cameroon, collected in formalin-aceto-alcohol (FAA) in the field. The extensive field notes of Keating, especially on *Keating BK90–12*, indicate only flowers with five anthers. It is unknown how frequent or consistent this character is in other populations, but it is clearly widespread geographically.

When growing in the open, *Tricarpelema africanum* tends to form mats. Where I observed it (*Faden et al. 86/23*) on the summit of Minloua Hill, near Yaoundé, Cameroon, plants were scrambling through shrubs in a thicket, the population having perhaps been overrun by the aggressive weedy shrub *Eupatorium odoratum* L. Parmentier et al. (2001), in a study of the vegetation of three inselbergs in Equatorial Guinea, recorded this species as occurring in "herbaceous and shrubby fringes" and "forest fringes" on these inselbergs. The two collections by Porembski et al., also from Equatorial Guinea, record the habitat as "*Afrotrilepis pilosa* mat."

The stems of this species are particularly stiff and almost wiry, much more so than in any other Commelinaceae observed with such slender stems. The older parts of the stems are covered by the persistent sheaths of old leaves, which no doubt reduce water loss.

Paratypes. CAMEROON. **Center Province:** Nkolbisson, 8 km W of Yaoundé, Minloua Hill, ca. 3 km NW of the town, 950 m, 24 Jan. 1986, *R. B. Faden, B. Satabié & B. Mpom 86/23* (US, YA); Yaoundé, Mar. 1940, *H. Jacques-Félix 5100* (P); Nkolbison, 8 km W of Yaoundé, Mt. Minloua, 950 m, 19 Nov. 1964, *J. & A. Raynal 11961* (YA); N'Kolbisson, near Yaoundé, ca. 700 m, 2 Nov. 1964, *W. J. J. O. & J. J. F. E. de Wilde & B. E .E. de Wilde-Duyfjes 3728* (BR, K, WAG). **South Province:** just before Ako'akas, lower slope of the NE face of the inselberg dominating the village, ca. 750 m, 2 Dec. 1989, *B. Keating BK89–12* (P, US, YA) [sterile], 21 Mar. 1990, *B. Keating BK90–3* (US), 23 June 1990, *B. Keating BK90–11* (P, US, YA); just before Ako'akas, on higher & S steep slopes of the inselberg, above 750 m, 30 June 1990, *B. Keating BK90–12* (P, US, YA); inselberg de'Akookas 3, près du village d'Akookas à 38 km SE d'Ebolowa, 720 m, 15 Mar. 2001, *I. Parmentier & Kouob 2041* (BRLU); approximately the same locality, 810 m, 18 Mar. 2001, *I. Parmentier & Kouob* 2144 (US); Akoakas, 27 km SE of Ebolowa, basses pentes du versant NE de l'inselberg dominant le village, 15 Feb. 1963, *J. & A. Raynal 9703* (YA); Akoakas Rock, 24 km on road (Old road) from N'Koemvone to Ambam, 11 Nov. 1974, *J. J. F. E. de Wilde 7697* (K). EQUATORIAL GUINEA. Rio Muni. **Centro Sur:** Bicurga, 22 Jan. 1999, *J. Lejoly 99/483* (US); Inselberg de Bicurga, près du village de Bicurga, 19 May 2002, *I. Parmentier & Esono 3101* (BRLU) [sterile]; same locality, 24 May 2002, *I. Parmentier & Esono 3253* (BRLU). **Wele Nzas:** région d'Anisok, au-dessus du village Nzamayong [= Nzuamayong], inselberg Akuom, 11 Sep. 1997, *S. Lisowski M-640* (BRLU); Momument naturel de Piedra Nzas, dalle rocheuse de Ncoho Biworo, 9 Jan. 1998, *J. Lejoly 99/244* (BRLU); Inselberg Nfuin [probably = Mfui], 14 May 1998, *N. Nguema 179* (US); Inselberg de Dumu, près du village de Dumu, 3 June 2002, *I. Parmentier & Esono 3586* (BRLU), grown from seed and cultivated at Smithsonian Institution, pressed 6 Apr. 2005, as *R. B. Faden 2005/002* (US); inselberg No. 1 nahe Mfui, 17 Mar. 1998, *S. Porembski, N. Biedinger & N. Nguema 3512* (BRLU) [sterile]; inselberg S of Mongomo, Dumo [= Dumu], 19 Mar. 1998, *S. Porembski, N. Biedinger & N. Nguema 3573* (BRLU, US). GABON: **Region between Ogooué and Cameroon:** sommet des rochers de Mangom, Nzec, 9 Nov. 1933, *G. Le Testu 9381* (P, US). **Woleu-Ntem:** Bordamur concession area, ca. 48 km from WWF-station, 15 Oct. 2002, *J. S. Strijk 177* (WAG). **Region Unknown:** mont Miwa, inselberg à 3 km du village de Kumassi, à 35 km d'Oyem vers Bitam, 29 Dec. 1999, *I. Parmentier & N. Nguema 548* (BRLU) [sterile]; mont Mengong, inselberg au pied du village de Nzec, 45 km de Mitzic vers Sam, 6 June 2000, *I. Parmentier & N. Nguema 586* (US, WAG); inselberg ca. 28 km ESE of Medouneu, 500 m, 3 Feb. 1986, *J. M. & B. Reitsma & A. M. Louis* 1810 (US) [sterile].

Tricarpelema brevipedicellatum Faden, sp. nov. TYPE: Vietnam. District Unknown: Ponjour près Djiring, avant des chutes, 24 Aug. 1924, *F. Evrard 1178* (holotype, P). Figure 2.

Herba perennis foliis spiraliter dispositis. Pedicelli 1.3–3 mm longi. Inflorescentia thyrsus laxus terminalis glaber. Flores petalis dimorphis duobus obovatis ca. 5 × 2 mm, triente oblanceolato ca. 3 × 1 mm; androecio staminum trium cis florem brevius antheris bilobatis et staminum trium trans florem longius antheris ellipticis. Capsulae triloculares loculis 1-seminalibus.

Decumbent perennial. Roots thin, fibrous. Leaves spirally arranged, neither clustered nor decrescent

distally (although the distalmost leaf on the flowering shoot much reduced), sheaths 0.9–1.3 cm, puberulous with a longitudinal band of short, uniseriate hairs along the fused edge, ciliate at the apex; lamina petiolate, elliptic to lanceolate-elliptic, 4–11 × 1.5–3 cm, apex acuminate, base cuneate, symmetric; margins planar to lightly undulate, scabrous with minute prickle-hairs distally, smooth elsewhere; surfaces glabrous (except for glandular micro-hairs). Inflorescence a simple, terminal, long-pedunculate, lax, ovoid, glabrous thyrse 3–4 cm (excluding the peduncle), 1.5–4.5 cm wide; peduncle 2.5–3.5 cm, glabrous; thyrse composed of 6 or 7 alternate, ascending cincinni; cincinni to 2.8 cm and 6-flowered; cincinnus peduncles 4–9.5 mm, cincinnus bracts (not seen) caducous; bracteoles spaced 1.5–3.5 mm apart, broadly ovate, amplexicaul but not perfoliate, ca. 0.5 mm, scarious, glabrous, caducuous. Flowers bisexual(?) and male; pedicels 1.3–3 mm, erect in fruit, glabrous; sepals strongly convexo-concave, almost equaling the capsules in fruit, 3–3.5 mm, strongly hooded and apparently glandular apically, glabrous; corolla with 2 petals apparently obovate, not clawed, ca. 5 × 2 mm, the 3rd petal oblanceolate, ca. 3 × 1 mm; stamens 6, 1-sided, the 3 stamens on the side of the flower with the smaller petal with longer filaments and smaller anthers than the other 3, filaments free, all slender, glabrous; the 3 stamens on the side of the flower with the larger petals dimorphic, the anthers of all 3 stamens with broad connectives, the antepetalous stamens with filaments 5.5 mm, the anthers 0.7 × 1.2 mm, V-shaped, bilobed, with small distal, stalked pollen sacs, the antesepalous stamen with filament 4 mm, anther ca. the same size as in the antepetalous stamens but dumbbell-shaped, with larger pollen sacs; the 3 stamens on the side of the flower with the smaller petal subequal, the filaments ca. 8.7 mm, glabrous, the anthers elliptic, ca. 0.75 × 0.60 mm, connective narrow; gynoecium not seen. Capsules trilocular, ovoid, 3–4 mm, light brown, lustrous, glabrous, cells of the wall ca. 2× longer than wide, locules 1-seeded. Seeds (not mature) with testa apparently white-farinose.

Distribution. Vietnam; known only from the two collections cited.

Habitat and phenology. Near waterfalls; flowering in June.

Conservation status. It is impossible to ascertain whether this species is genuinely rare or it has just been overlooked by collectors. In the apparent absence of recent collections, however, it should be considered endangered until proven otherwise.

The specimen *Hayata 847* is a mixed collection and was recognized as such, according to the annotations of Cherfils and citations in Cherfils (1937). *Hayata 847A* was annotated as *Aneilema divergens* (C. B. Clarke) C. B. Clarke [= *Murdannia divergens* (C. B. Clarke) G. Brückner], but it is *M. loriformis* (Hasskarl) R. S. Rao & Kammathy, which is quite unlike *M. divergens* in general appearance and details.

Hayata 847B and *Evrard 1178* were annotated by Cherfils and cited in Cherfils (1937) as *Aneilema montanum* (Wight) Wallich ex C. B. Clarke [= *Dictyospermum montanum* Wight]. That species is restricted to India and Sri Lanka. It differs from *Tricarpelema brevipedicellatum* by its generally larger leaves that are scabrous above, usually larger, laxer inflorescences, and longer pedicels. The other three collections from Indochina that were annotated and cited as *A. montanum* in Cherfils (1937) (i.e., *Poilane 10753* (P) from Vietnam; and *Kerr 21251* (P) and *Thorel s.n.* (P), both from Laos) were examined and are *D. conspicuum* (Blume) Hasskarl. They are easily separated from *T. brevipedicellatum* by their larger inflorescences with more numerous cincinni and larger capsules on longer, declinate pedicels. Both species of *Dictyospermum* further differ from *T. brevipedicellatum* by the pubescence of minute hook-hairs on the inflorescence axes and abaxial leaf surface.

The habitat recorded for the type, "avant des chutes," suggests a moist, riverine situation, probably growing in forest, but we cannot be certain.

The flower description comes from a single dissected flower of *Hayata 847B*. The gynoecium in the flower is very reduced and the flower must be male. It is safe to assume that at least some and probably most flowers in this species are bisexual, as they are in most Commelinaceae.

The three shorter stamens with broad connectives are on the side of the flower with the two larger petals. These anthers have dried bright yellow, which is usually indicative of the true color of stamens or staminodes in Commelinaceae flowers. They seem to produce pollen. The anthers of the other three stamens, on the side of the flower with the small petal, are much duller in color. They distinctly show pollen in the pollen sacs. Although one cannot clearly refer to the stamen sets as posterior and anterior from just the dried specimens, the short stamens with broad connectives and small pollen sacs are in the same morphological position, relative to the petals and sepals, as are the stamens of similar morphology in *Tricarpelema africanum* and all the other species of the genus that have been examined.

Paratype. VIETNAM. **District Unknown:** Bellvue [= Âp Phú Thuân] [près Dalat], 17 June 1921, *B. Hayata 847B* (P).

Figure 2. *Tricarpelema brevipedicellatum* Faden (*F. Evrard 1178* (P), holotype).

Synopsis of *Tricarpelema* J. K. Morton

With the description of the two new species, *Tricarpelema* may be fully described as follows:

Tricarpelema J. K. Morton, J. Linn. Soc. Lond., Bot. 59: 436. 1966. TYPE: *Tricarpelema giganteum* (Hasskarl) H. Hara.

Perennials. Leaves usually spirally arranged, with a petiolate lamina (rarely distichous with a sessile lamina). Inflorescences terminal and axillary thyrses, often glandular-pubescent. Bracteoles not perfoliate, persistent or caducous. Flowers bisexual or bisexual and male, slightly to moderately zygomorphic, with the outer, anterior petal similar to or slightly to strongly differentiated from the inner, posterior petals; petals shortly clawed or not clawed. Androecium composed of 6 stamens, the posterior 3 sometimes staminodial, all 3 similar to one another or the medial one morphologically distinct, the posterior 3 stamens always differentiated from the anterior 3, the medial of which is often differentiated from the lateral 2 anterior stamens. All filaments glabrous (except the anterior stamen filaments in *Tricarpelema glanduliferum*). Capsules equally trilocular and trivalved, or sometimes indehiscent (but then never metallic blue, as in *Pollia* Thunberg), locules 1- to 9-seeded. Seeds uniseriate, with a linear hilum and lateral to semidorsal embryotega. Hook-hairs (as defined by Tomlinson, 1966, 1969) lacking from all parts of the plant.

In his description of *Tricarpelema*, Morton (1966) recorded the capsules as having two rows of seeds in each locule. Clarke (1881), however, described the ovules as being borne in two rows in "*Aneilema thomsonii*" [= *Tricarpelema giganteum*], Morton's sole species of *Tricarpelema*, but the seeds as all superposed in the locule and therefore uniseriate. Thus Morton's description was inaccurate. The seeds, where they are known, are always uniseriate.

The African species is sufficiently distinct from the Asian taxa to warrant separation as a distinct subgenus. The subgenera and species of *Tricarpelema* may be distinguished by the following key:

Key to the Subgenera and Species of *Tricarpelema*

1a. Leaves distichous, lamina sessile, moderately succulent, glandular-pubescent; African species (subgenus *Keatingia*) . . . . . 1. *T. africanum*
1b. Leaves spirally arranged, lamina petiolate, not succulent, glabrous to puberulous, not glandular-pubescent; Asian species (subgenus *Tricarpelema*) 2
2a. Inflorescences conspicuously pedunculate; continental Asia 3
3a. Inflorescence glabrous or with eglandular hairs 4
4a. Pedicels 5.5–10 mm (8–17 mm in fruit); capsules ellipsoid, 15–20 mm, locules 5- to 9-seeded; leaves 11–25 × 1.5–7.5 cm . . . . . 2. *T. giganteum*
4b. Pedicels 1.3–3 mm; capsules ovoid, 3–4 mm, locules 1-seeded; leaves 4–11 × 1.5–3 cm . . . . . 3. *T. brevipedicellatum*
3b. Inflorescence glandular-pubescent 5
5a. Leaves 3–12 × 1.5–2.8 cm; capsules 7–8 mm, locules 2-seeded; anterior (longer, lower) stamens with bearded filaments . . . . . 4. *T. glanduliferum*
5b. Leaves 9–30 × 2.2–7 cm; capsules (unknown in *T. xizangense*) 13–15 mm, locules 4- to 5-seeded; all filaments glabrous 6
6a. Posterior petals orbicular, clawed; style to 15 mm; pedicels 3–5 mm in flower, 5–10 mm in fruit; leaves 15–30 × 4–7 cm . . . . . 5. *T. chinense*
6b. Posterior petals ovate-elliptic, not clawed; style < 10 mm; pedicels ca. 7 mm in flower and fruit; leaves 9–14 × 2.2–4.5 cm . . . . . 6. *T. xizangense*
2b. Inflorescences sessile or subsessile; Philippines and Borneo 7
7a. Inflorescences composed of 1 to 12(to ca. 25) cincinni; capsules subspherical, 3–4 mm; locules 1-seeded . . . . . 7. *T. philippense*
7b. Inflorescences composed of 1 to 4 cincinni; capsules ellipsoid, 4.5–6 mm; locules 3- to 4-seeded . . . 8. *T. pumilum*

I. Tricarpelema subg. **Keatingia** Faden, subgen. nov. TYPE [and sole species]: *Tricarpelema africanum* Faden.

A subgenere typico foliis distichis lamina sessile moderate succulenta glanduloso-pubescenti differt.

Leaves distichous, lamina sessile, moderately succulent, distichous, glandular-pubescent.

Etymology. Named in honor of U.S. Peace Corps Volunteer William F. (Bill) Keating, who, while in service in southern Cameroon, made collections and observations of *Tricarpelema africanum* that greatly increased our knowledge and understanding of the species.

1. **Tricarpelema africanum** Faden (see above and Fig. 1).

II. Tricarpelema J. K. Morton subg. **Tricarpelema**, J. Linn. Soc. Lond., Bot. 59: 436. 1966.

TYPE: *Tricarpelema giganteum* (Hasskarl) H. Hara.

Leaves spirally arranged, lamina petiolate, thin-textured, glabrous or eglandular-pubescent.

2. Tricarpelema giganteum (Hasskarl) H. Hara, Fl. Eastern Himalaya 2: 160. 1971. Basionym: *Dichoespermum giganteum* Hasskarl, Commel. Ind., 42. 1870. *Aclisia ? thomsonii* C. B. Clarke, Commel. et Cyrt. Beng., 46, Tab. 31. 1874, replacement name for *Dichoespermum giganteum* Hasskarl, 1870. *Aneilema ? thomsonii* (C. B. Clarke) C. B. Clarke, J. Linn. Soc., Bot. 15: 121. 1877. *Aneilema thomsonii* (C. B. Clarke) C. B. Clarke in DC., Monogr. Phan. 3: 202. 1881. TYPE: [India.] Sikkim: *J. D. Hooker s.n.* [*Aneilema* sp. 11 in herb. Hook. f. et Thomson] (lectotype, designated here, K [fruiting specimen]; isotypes, B†, K [2 sheets, flowering], P [2 sheets], W†).

Distribution. Bhutan, India (Sikkim, West Bengal (Darjeeling District), Arunchal Pradesh, Nagaland).

The combinations *Tricarpelema thomsonii* (C. B. Clarke) J. K. Morton (J. Linn. Soc., Bot. 59: 436. 1966) and *Tricarpelema thomsonii* (C. B. Clarke) R. S. Rao (Third All India Bot. Conf. Abstracts. J. Ind. Bot. Soc. 59., Suppl., ii. 1980) are invalid, and so they have been omitted from the above synonymy.

The inflorescences in this species are essentially glabrous, in contrast to those of the two related Chinese species, which are glandular-pubescent. Sometimes sparse, short, uniseriate, eglandular hairs may be present on the inflorescence axes. Rarely a few, short, glandular hairs may be present, especially in specimens from Nagaland (e.g., *Koelz 25919*). The leaves in all of the specimens cited below were found to be scabrous adaxially due to the presence of numerous, minute prickle-hairs.

The flowers are bisexual and male. Clarke on the label of *Clarke 26966A* mentions that the ovary is aborted in many flowers, and a transparency furnished by H. J. Noltie of a plant from Darjeeling District (*ESIK 1069*) shows a flower that clearly lacks a gynoecium and must be male.

The petals are described by Clarke (1881) as scarcely clawed. From his drawing on *Clarke 26966A* and the flower in the transparency from Noltie, I would call them sessile. The three petals are similar in size, but the lower (anterior) one seems to be slightly broader and perhaps a little longer.

The fertility of the short, posterior stamens may be variable. Noltie (1994) stated that they are staminodial. Clarke on the label of *Clarke 26966A* stated that "one of the short rudimentary stamens sometimes contains [an] imperfect anther with apparently good pollen." Of course, that pollen could be sterile or produced in such small amounts that its contribution to pollination might be negligible. Among the three consistently fertile stamens, the medial one always has a much shorter filament than the other two, and its anther is of a different form from theirs.

Additional specimens examined. INDIA. **Sikkim:** Khursiong, 2135 m, 28 Sep. 1882, *C. B. Clarke 35962* (G); Sikkim, 610–1525 m, *J. D. Hooker s.n.* (K, P [2 sheets]). **West Bengal:** Darjeeling District, Darjeeling, 1980 m, 13 Aug. 1875, *C. B. Clarke 26966A* (K); Darjeeling, below Observatory Hill, 2150 m, 4 Aug. 1992, *D. G. Long et al. in ESIK 1110* (US). **Nagaland:** Pulebudge, Naga Hills, 1830 m, 4 Aug. 1935, *N. L. Bor 5301* (K); Takubama, Naga Hills, 25 Aug. 1950, *W. N. Koelz. 25919* (MICH); same locality, 3 Sep. 1950, *W. N. Koelz 26029* (MICH). Without Country: Himalaya, ex Herb. Kew, s. coll. s.n. (G).

3. Tricarpelema brevipedicellatum Faden (see above and Fig. 2).

4. Tricarpelema glanduliferum (J. Joseph & R. S. Rao) R. S. Rao, Third All India Bot. Conf. Abstracts. J. Indian Bot. Soc. 59, Suppl., ii, iii. 1980. Basionym: *Aneilema glanduliferum* J. Joseph & R. S. Rao, J. Indian Bot. Soc. 47: 367, fig. 1–7. 1968. TYPE: India. NEFA [Arunchal Pradesh]. Kameng District: Tipi, N Bhalukpong, on the way to Krishna, near the bank of river Bharali, 1250 m, 10 Sep. 1964, *J. Joseph 39707A* (holotype, CAL not seen; isotypes, *39707D*, *39707F*, both K).

Other isotypes are cited from ASSAM, BSI, DD, E, GH, and L, but the sheet cited for E is actually at K.

Distribution. India (Arunchal Pradesh) and Vietnam.

This is a very distinctive species because of its small leaves and small, densely glandular-pubescent inflorescences with just a few cincinni. It is also the only species of the genus that has bearded stamen filaments. The three shorter posterior filaments are glabrous, whereas the three longer, anterior filaments are bearded with very short, apparently one-celled trichomes that were clearly seen in the spirit collection of the type at Kew and were definitely present, but less clear in their morphology, in a dissected bud of *Harder et al. 5415* (US). Although the two collections are very similar in overall appearance, there are some significant differences in the flowers. That of the type has an ovate lower petal, whereas that of the Vietnamese collection has a lanceolate-oblong lower petal. The shape of the

various anthers also seems to be rather different in the two flowers. The fruits in the Vietnamese collection are unknown. In view of the limited material, it is not worthwhile doing anything further than noting the variation. Only further collections will show whether these differences are significant.

Additional specimens examined. VIETNAM. **Vi Xuyen Distict:** Cao Bo municipality, Tam Ve village, Ha Giang, 1700–1800 m, 10 Sep. 2000, *D. K Harder, N. V. Du, N. Q. Hieu & P. K. Loc 5415* (US).

5. Tricarpelema chinense D. Y. Hong, Acta Phytotax. Sin. 12: 475, Pl. 92. 1974. TYPE: China. Sichuan: Le Shan, 1500 m, 25 Aug. 1931, *J. Tang 23593* (holotype, PE not seen).

Distribution. China: Sichuan Province.

6. Tricarpelema xizangense D. Y. Hong, Acta Phytotax. Sin. 19: 529, Fig. 1. 1981. TYPE: China. Xizang: Medog, De-er-gong, 1750 m, 20 Aug. 1974, *Qinghai-Xizang Expedition 74-4398* (holotype, PE not seen).

Distribution. China: Xizang Province.

In *Flora Xizangica* Hong (1987) used the name "*Tricarpelema tibetica* Hong" for this species, without an explanation. I can only assume that the epithet for the species was misremembered and was not checked before publication. The name is a nomen nudum.

7. Tricarpelema philippense (Panigrahi) Faden, Smithsonian Contr. Bot. 76: 153. 1991. Basionym: *Dictyospermum philippense* Panigrahi, Phytologia 29: 338. 1975, replacement name for *Aneilema humile* Merrill, Philipp. J. Sci. 13: 4. 1918, nom. illeg., non *Aneilema humile* Warburg, 1891. TYPE: Philippines. Alabat Island: back of Sangirin, 24 Dec. 1916, *E. D. Merrill 10459* (lectotype, designated here, US; isotype, K).

Pollia subumbellata C. B. Clarke var. *glabra* Hallier f. in Beih. Bot. Centralbl. 34, Abth. 2, 1: 52. 1917. Syn. nov. TYPE: Indonesia. Kalimantan, North Borneo: Gunung Djempanga, Sep. 1912, *Amdjah 749* (lectotype, designated here, BO; isotype, L).

The other syntypes are: West Borneo: Bukit Moang, *Exped. Nieuwenhus 1896-87 No. 995* (BO); Sungei Kelassar, 24 Dec. 1893, *H. Hallier B1547* (BO); Liang Gagang, 21 Mar. 1894, *H. Hallier B2804* (BO, L); North Borneo: Sedalir, 25 July 1912, *Amdjah 217* (BO).

Distribution. Philippines (Alabat, Cebu and Luzon Islands), Malaysia (Sabah, Sarawak), and Indonesia (Kalimantan).

The capsules in this species seem to be indehiscent. Capsules that are open appear broken, without regular lines of dehiscence, but it is possible that they may be tardily dehiscent, especially in some specimens from the Philippines. The subsessile inflorescences and apparently indehiscent fruits have probably been the cause of many specimens of this species being identified as *Pollia subumbellata* and of the description of *P. subumbellata* var. *glabra*. *Pollia subumbellata*, however, is confined to continental Asia and differs from *Tricarpelema philippense* by its persistent, perfoliate bracteoles, metallic blue fruits with several-seeded locules, biseriate seeds, and the presence of hook-hairs on the leaves and inflorescences.

Two flowers of *Tricarpelema philippense* (*Bicknell 716*), field collected in spirit, have petals that are not clawed. The posterior two are suborbicular whereas the anterior one is smaller and obovate. The filament bases are shortly fused. The three posterior stamens have relatively broad connectives and small distal pollen sacs with introrse dehiscence. The medial stamen is shorter than the other two. The anterior stamens are longer, with thicker filaments. Their anthers are broadly elliptic with a narrow connective and much larger pollen sacs with an introrse dehiscence. These three stamens are equal. All six stamens produce pollen. The style tapers distally from its base and slightly exceeds the stamens.

A dissected flower of *Tricarpelema philippense* from *Elmer 20177* (MO) was very similar to the above except that the dehiscence of the posterior stamens and filament fusion were not noted. An open flower on *Beaman 10627* (US) showed both sets of stamens with narrow connectives, but with the posterior set with much smaller pollen sacs than the anterior stamens, as in the above collections.

Plants of *Tricarpelema philippense* from Borneo are, on the whole, larger than those from the Philippines. A more thorough study is needed in order to determine whether they should be recognized taxonomically.

Selected specimens examined. PHILIPPINES. **Alabat:** Sangirin, 24 Dec. 1916, *E. D. Merrill 10459* (K, US). **Cebu:** Kautipla, Apr. 1995, *D. Bicknell 716* (US). **Luzon:** Camarines Sur, Agosais, Oct. 1928, *G. Edaño 119 in Bureau of Science 76114* (MICH, NY); Mt. Isarog, Nov.–Dec. 1913, *M. Ramos in Bureau of Science 22082* (K, L, P, US). MALAYSIA. **Sabah:** Lahad Datu District, Bukit Blachan, at Lahad Datu–Sandakan Road ferry, 100–150 m, 13 June 1984, *J. H. Beaman 10125* (US). **Myburgh Province:** Sandakan, Oct.–Dec. 1921, *A. D. E. Elmer 20177* (BO, K, L, MO, SING). **Ranau District:** road from Lohan to Mamut Copper mine near Tank 80, 900 m, 9 July 1984, *J. H. Beaman 10627* (US). District Unknown: Sepilok Forest Reserve, 19 Sep. 1963, *W. Meijer 34302* (K, L). **Sarawak:** Upper Baram, Salungu, 22 Nov. 1914, *J. C. Moulton 59* (SING); Liu Malir, 1920, *J. C. Moulton 6706/3* (SING).

INDONESIA. **Borneo:** Kalimantan, Selatin Hill, 2 km S of Djaro Daun, 22 Nov. 1971, *J. Dransfield & D. Saerudin 2292* (L); W. Koetai, No. 24, L. Iboet, 17 Aug. 1925, *F. H. Endert 2590* (BO, L); Bükit Lebang Temarüi by Lebang Harü, 5 Dec. 1924, *H. Winkler* 602 (L); Sungei Kelassar, 24 Dec. 1893, *H. Hallier B1547* (BO); Liang Gagang, 21 Mar. 1894, *H. Hallier B2804* (BO, L).

8. Tricarpelema pumilum (Hallier f.) Faden, Checklist Fl. Pl. Gymn. Brunei, 435. 1996. Basionym: *Pollia pumila* Hallier f., Beih. Bot. Centralbl. 34, Abth. 2, 1: 52. 1916. TYPE: Indonesia. Kalimantan: Sungei Tepussey ["Soengei Tepoessey" on label], 1896–1897, *Exped. Nieuwenhuis 1896-97 No. 764* (lectotype, designated by Faden in Cowley & Faden, 1996: 435, BO).

The other syntypes are: Sungei Blu-u ["Soengei Bloe-oe" on label], 1896–1897, *Exped. Nieuwenhuis 1896-97 No. 520* (BO) [sterile]; Ulu Buleng ["Oeloe Boeleng" on label], 2 Jan. 1899, *Exped. Nieuwenhuis 1898-1899 No. 395* (BO, L) [sterile].

Distribution. Indonesia (Kalimantan), Malaysia (Sarawak) and Brunei. Endemic to Borneo.

Only one of the three syntypes is fertile. Therefore I lectotypified the species with *Exped. Nieuwenhuis 1896–97 No. 764* (BO), the only fertile sheet, which is in flower (Cowley & Faden, 1996).

The best flowering material of *Tricarpelema pumilum* seen was in *Paulsen 187*. The paired petals were oblanceolate and not clawed. The third petal was similar but smaller. The three posterior stamens were staminode-like, with yellow anthers and pollen produced in small pollen sacs with apparently latrorse dehiscence. The medial posterior stamen had a shorter filament than the other two. The three anterior stamens were equal, with broadly elliptic anthers with narrow connectives and much larger pollen sacs than the posterior stamens, with introrse dehiscence. Their filaments were about the same length as those of the lateral posterior filaments. The style was much longer than the stamens.

Tricarpelema pumilum resembles a miniature or depauperate specimen of *T. philippense*. The best characters to separate this species from a small specimen of *T. philippense* are capsule shape and size and number of seeds per locule. In the absence of fruits, such specimens are difficult to distinguish, although this study suggests that certain floral differences, such as petal shape, may be useful, but only a small number of specimens have been examined.

Additional specimens examined. INDONESIA. **Kalimantan:** W. Koetai, no. 36, near L. Petah, 13 Sep. 1925, *F. H. Endert 3270* (BO, GH, K, L); Sungei Blu-u, 1896–1897, *Exped. Nieuwenhuis 1896–97 No. 520* (BO) (sterile); Ulu Buleng, 2 Jan. 1899, *Exped. Nieuwenhuis 1898–1899 No. 395* (BO, L) (sterile). MALAYSIA. **Sarawak:** Sungain Marting, Bena Sut, Kapit, 7th Division, 9 Nov. 1988, *Hj. Othman, Rantai & Jugali in Sarawak For. Dept. S 62155* (K). BRUNEI. **Temburong Province:** Batu Apoi Forest Reserve, Sungai Belalong, 23 June 1991, *A. D. Poulsen 187* (K).

Undescribed species. Noltie (1994) stated that specimens of *Tricarpelema* from Burma have a glandular-pubescent inflorescence and therefore do not belong to *T. giganteum*. I have studied three collections of *Tricarpelema* from Burma, and they all have a glandular pubescence, so I agree with Noltie. *Kingdon-Ward 21434* (GH) also does not match either Chinese species because of its very long flowering and fruiting pedicels (10–15 mm and 13–21 mm, respectively). Most likely it represents a distinct species. The other two collections, *Forrest 24867* (K) and *Naw Mu Pa 17431* (K), do not agree with either *T. giganteum* or *Kingdon-Ward 21434*, but it is unclear whether they match either of the Chinese species. Obviously, additional collections are needed.

Discussion

Tricarpelema africanum has been known to me for many years. It has proven difficult to cultivate and thus far has not yielded a chromosome count or a DNA sequence. Moreover, I have not been able to obtain living or DNA material of any of the Asian species for comparison. Even herbarium specimens of most species are quite scarce, e.g., *T. glanduliferum* (known from two collections), *T. brevipedicellatum* (two collections), and *T. pumilum* (six collections seen of which two were sterile). Specimens of neither Chinese species have been examined. Thus our knowledge of the genus as a whole is very incomplete, as is that of the new species, to varying degrees.

The only published chromosome count attributed to the genus is n = ca. 24 for *Tricarpelema giganteum* (Rao, 1978; Rao et al., 1968, 1970) (erroneously cited as $2n$ = ca. 46, in Faden, 1998). Rao et al. (1968, 1970) cited the plant counted by Panigrahi and Kammathy (1963a, b) under *Aneilema aequinoctiale* (P. Beauvois) G. Don as belonging to *A. thomsonii* (C. B. Clarke) C. B. Clarke [= *Tricarpelema giganteum*], but the plant described as *A. aequinoctiale* in Panigrahi and Kammathy (1963a) and described and illustrated in Panigrahi and Kammathy (1963b) is neither *T. giganteum* nor *A. aequinoctiale*, an African species that was erroneously described from India as the monotypic genus *Amelina wallichii* C. B. Clarke. From the description of the plant as having hairy leaves and stems (Panigrahi & Kammathy, 1963a), and the illustrations showing the flower with three

stamens on one side and lacking staminodes and the capsule with one-seeded locules, "*A. aequinoctiale*" of Panigrahi and Kammathy (1963a, b) exactly agrees with the genus *Dictyospermum*, although it is not clear which species of the genus Panigrahi and Kammathy (1963b) might have seen in Darjeeling, India. However, the chromosome count $n = 24$ does not agree with those for *Dictyospermum*, which are based on $x = 14$ (Faden, 1998, unpubl. data), but perhaps the count was just inaccurate. Finally, Panigrahi and Kammathy (1963b) illustrated *A. thomsonii*, but they omitted a chromosome number for it. Thus, unless there is a voucher specimen for the $n =$ ca. 24 count, which neither these authors nor Rao et al. (1968, 1970) referred to, it may be concluded that whatever the plant that was counted as $n = 24$ by Panigrahi and Kammathy (1963a, b) was, it was not *T. giganteum*, and therefore there are no published chromosome counts that actually refer to *Tricarpelema*.

One last point is the accuracy of the $n = 24$ count itself. Rao (1978) and Rao et al. (1968, 1970) referred to it as "ca. 24," but Panigrahi and Kammathy (1963a, b) did not indicate any doubt as to its exactness. However, Panigrahi and Kammathy (1963a) referred to one cell as having 23 bivalents and one quadrivalent, which is illustrated, but not very convincingly, by means of a fuzzy photograph in Panigrahi and Kammathy (1963b). In Panigrahi and Kammathy (1963a) they referred to "other cells" as having 24 clear bivalents, but in Panigrahi and Kammathy (1963b) they stated that they found "n = 24 in one cell and...22 bivalents [sic] and one quadrivalent in another cell." Thus there is inconsistency in both the number of bivalents in the cell with the one quadrivalent and also in the number of cells reported with 24 bivalents. Therefore, the count reported should be treated as approximate (i.e., $n =$ ca. 24), but the identity of the plant is uncertain.

The generic position of the new species, and especially of *Tricarpelema africanum*, needs to be considered. The most distinctive features of *Tricarpelema* are the androecium composed of two sets of stamens, the posterior three stamens usually shorter and possibly staminodial in some species, and the anterior three stamens usually longer and always fertile. The ovary and capsule are equally trilocular, and the capsule is trivalved or rarely indehiscent. The inflorescences are often glandular-pubescent, and two-celled hook-hairs, which are present in all species of *Dictyospermum*, are lacking.

The floral structure of *Tricarpelema brevipedicellatum* has been determined from a single flower, and it agrees with the description of the genus. The trilocular capsules were not mature, so their dehiscence has not been confirmed. Mature seeds have not been seen. In its one-seeded capsule locules and lack of glandular hairs, this species agrees with *T. philippense*, but unlike that species *T. brevipedicellatum* has a pedunculate, more obviously thyrsiform inflorescence that is similar to those of the other mainland Asian taxa. Clearly more collections of this species are needed, but its generic position is not in doubt.

The case for *Tricarpelema africanum* is different. The inflorescence, flower, capsule, and seed morphologies agree with *Tricarpelema* without any problems. It is the vegetative morphology and ecology that are so different from the Asian species of the genus. The distichous, succulent leaves with a sessile, glandular-pubescent lamina in *T. africanum* are very different from the thin, spirally arranged leaves with a petiolate lamina that lacks glandular pubescence in the Asian species. *Tricarpelema africanum* grows on granitic hills, mainly in sunny situations. The Asian species of *Tricarpelema*, insofar as the habitats are known, are forest understory plants, and their foliage resembles that of species of other forest genera of Commelinaceae such as *Pollia* and *Dictyospermum* (except for the absence of hook-hairs).

For the sake of completeness, *Tricarpelema africanum* needs to be compared with two other genera, the African endemic *Stanfieldiella* Brenan and the pantropical but mainly African *Floscopa* Loureiro. These genera of tribe Commelineae share with *T. africanum* the characters of compound thyrses, the presence of glandular hairs on the inflorescence, and the absence of hook-hairs from all parts. With *Stanfieldiella*, it further shares a trilocular ovary and trilocular, trivalved capsule. With *Floscopa*, it further shares flowers with bilateral symmetry, an androecium differentiated into anterior and posterior sets of fertile stamens, and a stipitate capsule. Some species of *Floscopa*, e.g., *F. glomerata* (Willdenow ex J. A. & J. H. Schultes) Hasskarl, also have leaves with a sessile lamina, and at least one species, *F. schweinfurthii* C. B. Clarke, has glandular hairs on its leaves.

Tricarpelema africanum is clearly distinct from both *Stanfieldiella* and *Floscopa* in its large, lax inflorescence and succulent, distichous leaves. It further differs from *Stanfieldiella* by its zygomorphic (vs. actinomorphic) flowers with an androecium composed of two sets of stamens (vs. stamens all equal). It further differs from *Floscopa* by its trilocular ovary and trilocular, trivalved capsules, with the locules several-seeded (vs. bilocular ovary and bilocular, bivalved capsules with one-seeded locules). It clearly shares more characters with *Floscopa* than with *Stanfieldiella*, but the ovary and capsule characters are so fixed in *Floscopa* that the similarities present are almost certainly the result of convergence. *Floscopa* species occur in wet places and some are

aquatics, whereas *T. africanum* is clearly adapted for more xeric conditions.

Tricarpelema shows a disjunct distribution, with one species in Central Africa and the rest in tropical Asia. The genus *Amischotolype* Hasskarl (Commelinaceae) (two rainforest species, including one undescribed, in Central Africa, the other ca. 14 species in tropical Asia) shows a similar disjunct distribution pattern, as does *Calamus* L. (Arecaceae), with one variable or nine closely related species in West Africa and the remaining ca. 360 species distributed from tropical Asia to Australia and Fiji (Dransfield, 1986). In all three examples, the African species are few in number and occur in the rainforest zone. Only in *Tricarpelema* has the African species substantially changed its habitat, compared with its Asian congeners, and adapted to inselbergs.

The most likely explanation is that *Tricarpelema africanum* evolved from rainforest relatives that went extinct, perhaps due to the aridification of Africa and the reduction of the forest cover. The species still has the essential reproductive features that allow us to determine its most likely generic position, but the vegetative features have become modified as an adaptation to a moisture-limiting environment.

Tricarpelema is obviously in need of more collecting and further study. Among the known taxa, *T. giganteum*, the two Chinese species, and the taxa from Burma seem to form a natural group, as do the two species in Borneo. The relationships of the remaining three species, *T. glanduliferum* and the two species described in this paper, are completely unknown.

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Critical Notes on the Genus *Dontostemon* (Brassicaceae)

Dmitry A. German
South-Siberian Botanical Garden, Altai State University, 656049, Lenina St. 61, Barnaul, Russia. oreoloma@rambler.ru

Abstract. Notes on the taxonomy and geography of the genus *Dontostemon* Andrzejowski ex C. A. Meyer (Brassicaceae) are given. *Torularia sergievskiana* Polozhij is reduced to synonymy of *D. pinnatifidus* (Willdenow) Al-Shehbaz & H. Ohba, and *D. glandulosus* (Karelin & Kirilov) O. E. Schulz is excluded from the flora of Russia. A new subspecies, *D. senilis* Maximowicz subsp. *gubanovii* D. German (northwestern Mongolia), is described. *Dontostemon intermedius* Voroschilov is recognized as an independent species instead of a synonym of *D. dentatus* (Bunge) Ledebour.

Key words: Brassicaceae, *Dimorphostemon*, *Dontostemon*, Far East, Mongolia, Russia, *Torularia*.

The central and eastern Asian genus *Dontostemon* Andrzejowski ex C. A. Meyer (Brassicaceae), which currently includes *Dimorphostemon* Kitagawa and *Alaida* Dvořák, has been the focus of several taxonomic studies (Golubkova, 1950, 1974a, b, 1976; Dvořák, 1971; Al-Shehbaz, 2000; Al-Shehbaz & Ohba, 2000). These authors have differed in their delimitation of the genus (for further information, see Al-Shehbaz & Ohba, 2000). According to Zhou et al. (2001), *Dontostemon* includes 11 species and one subspecies. A critical study of the Siberian, Far Eastern, and Mongolian material of *Dontostemon* yields additional information on synonymy, distribution, and the nomenclatural novelties discussed herein.

Status of *Dimorphostemon sergievskianus*

Dontostemon pinnatifidus (Willdenow) Al-Shehbaz & H. Ohba, Novon 10: 96. 2000. Basionym: *Cheiranthus pinnatifidus* Willdenow, Sp. Pl. 3(1): 523. 1800. TYPE: Siberia, *Stephan s.n.* (holotype, B-W 12111).

Torularia sergievskiana Polozhij, Novosti Sist. Vyssh. Rast. 11: 210. 1974. Syn. nov. *Dichasianthus sergievskianus* (Polozhij) Soják, Sborn. Nár. Muz. Praze, 1982(1–2): 107. 1982. *Dimorphostemon sergievskianus* (Polozhij) Ovczinnikova, Fl. Sib. 7: 100. 1994. *Neotorularia sergievskiana* (Polozhij) Czerepanov, Vasc. Pl. Russia & Adj. States (former USSR): 145. 1995. TYPE: Russia. Tuva: [eastern] Tannu-Ola Range, vic. of the Shurmak, Soya valley, 10 June 1971, *Y. Surov, S. Vydrina & V. Kurbatsky s.n.* (holotype, TK; isotype, LE).

The species was originally described as *Torularia sergievskiana* Polozhij from southern Siberia (Tuva, eastern Tannu-Ola range) and compared to the central Asian *T. glandulosa* (Karelin & Kirilov) Vassilczenko (Polozhij, 1974). However, the generic placement of the latter species was shown to be artificial (Dvořák, 1971), and Golubkova (1974a) transferred it to *Dimorphostemon*. In her revision of *Dimorphostemon*, Golubkova (1976) did not deal with *T. sergievskiana*. The species was later recognized as *Dichasianthus sergievskianus* (Polozhij) Soják (Soják, 1982), *Dimorphostemon sergievskianus* (Polozhij) Ovczinnikova (Rybinskaya, 1994), and *Neotorularia sergievskiana* (Polozhij) Czererpanov (Czerepanov, 1995). Both Golubkova (1950) and Al-Shehbaz and Ohba (2000) disagreed with Kitagawa (1939) and reduced *Dimorphostemon* to synonymy with *Dontostemon*. This position is well supported by recent molecular studies on *Dontostemon* (Bleeker et al., unpublished).

Dimorphostemon sergievskianus was treated as a synonym of *Dontostemon glandulosus* (Karelin & Kirilov) O. E. Schulz (Zhou et al., 2001), and such placement implied that the latter species occurs in and is reported for the first time from Russia. However, these authors did not examine the holotype of the former species, and they may have overlooked the slight differences in flower shape and size between the two species. A critical study of the type collection of *Dimorphostemon sergievskianus* shows that it is indistinguishable in flower shape and size (obovate, 5.5–6.5 × 4.5–5 mm) and in the presence of distinct filament teeth from *Dontostemon pinnatifidus* (petals obovate, (5–)6–8 × (2.5–)3–4(–5) mm), a species widely distributed in central and eastern Asia (Zhou et al., 2001) and very common in Siberia and the Russian Far East (Berkutenko, 1988; Rybinskaya, 1994). By contrast, *Dontostemon glandulosus* has no filament teeth, has spathulate petals measuring 2–4(–4.5) × (0.5–)1–1.5(–2) mm, and has a geographical distribution in the west of central Asia and adjacent Tajikistan and Kazakhstan (Zhou et al., 2001). Therefore, *Dimorphostemon sergievskianus* should be treated as a synonym of *Dontostemon*

pinnatifidus and not *Dontostemon glandulosus*. Thus, the latter species does not occur in Russia, and records of its occurrence in the Kazakh Altai (Vassilyeva, 1961; Golubkova, 1976) still need confirmation (German, 2003a).

Until recently, the type locality of *Torularia sergievskiana* was one of the most western records of the conspecific *Dontostemon pinnatifidus* from Siberia, a fact that could be considered proof of probable allopatry of the two taxa. The following finding of *D. pinnatifidus*: "Russia. Tuva Republic, Ovyur district, branches of western Tannu-Ola range, valley of Arzaity, southern slope of Arzaity peak, 50°28′N, 90°50′E, 29 June 2001, *P. Kossaczev & A. Vastchenko, KV 681*" (ALTB) (German, 2002) expands the distribution range of the species westward; thus, the locus classicus of *T. sergievskiana* falls inside the distribution area of *D. pinnatifidus*.

Torularia sergievskiana is a synonym of the type subspecies, *Dontostemon pinnatifidus* subsp. *pinnatifidus*, which is the only one of the two subspecies of *D. pinnatifidus* distributed in Russia. This identity was first revealed by V. P. Botschantzev. The isotype of *T. sergievskiana* was determined by him in 1974 as *D. pectinatus* (DC.) Ledebour [= *D. pinnatifidus* s. str.], but this information was never published.

A New Subspecies of *Dontostemon senilis* from Western Mongolia

Many collections of *Dontostemon* from western Mongolia, reported as *D. elegans* Maximowicz and *D. crassifolius* Bunge by Grubov (1982) and Gubanov (1996), do not belong to these species (German, 2003b). Except for a few hairs (on leaf margins and occasionally on sepals of young plants), these misidentified collections resemble *D. crassifolius*, but they differ from *D. elegans*, which has more numerous subappressed trichomes and tufts on the sepals, at least when young. Those collections differ from *D. crassifolius* by having longer (4–5.5(–6) cm vs. 2–2.5 cm) fruits with shorter (up to 0.7 mm vs. 1.5–2.5 mm) styles, and taller stems (up to 30 cm vs. 5–15 cm high); they differ from *D. elegans* by having narrower (up to 1.5 mm vs. 2–2.5 mm) fruits; and they differ from both species by the straight (not arcuate, crescent, or twisted) and erect fruits on ascending (not horizontally divaricate or even slightly descending) pedicels and somewhat fleshy (when alive) but not leathery leaves.

These differences suggest that the specimens in question should be attributed to *Dontostemon senilis* Maximowicz. However, the collections differ from typical *D. senilis* in some morphological characters discussed below, which are also supported by different distribution ranges; therefore, those collections are recognized herein as a distinct subspecies.

Dontostemon senilis Maximowicz, Bull. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 3, 26: 421. 1880. TYPE: [China. Nei Mongol]: Mongolia occidentalis, Terra Ordos, valle Hoangho medii, in rupibus jugi ripae sinistrae rara [lacus Gashunnor], 15/27 May 1872, [fl, fr], *N. M. Przewalski s.n.* (lectotype, designated by Grubov, 2000: 69, LE).

Dontostemon senilis subsp. **gubanovii** D. German, subsp. nov. TYPE: Mongolia. SE bank of Atschit-Nuur (Ubsunur aimak), 1500 m, rock crevices in desert steppe, 28 Aug. 1984, *I. A. Gubanov 9221* (holotype, MW).

A *D. senili* Maximowicz s. str. subglabritia et stylo breviore (0.1–0.7 mm, non (1–)1.5–3(–3.5) mm) differt.

The basic morphological difference separating the new subspecies is a strong reduction of indumentum. Plants of *Dontostemon senilis* subsp. *gubanovii* are glabrous throughout except for ciliae 0.3–1.2 mm on leaf margins of sterile caudex rosette leaves and a few short hairs on the distal part of leaf margins of some cauline leaves and occasionally also on sepals; stems and leaf surfaces are always glabrous. In contrast, leaves, including both leaf margin and surface, and at least the lower half of stems in specimens of *D. senilis* s. str. are moderately to densely pilose with subsetose trichomes to 3 mm long. Another morphological peculiarity of the new subspecies is a very short style, 0.1–0.7 mm versus (1–)1.5–3(–3.5) mm in typical *D. senilis*, though this difference can only be treated as secondary because the style length in *D. senilis* is highly variable.

Distribution and habitat. Ecologically, *Dontostemon senilis* subsp. *gubanovii* appears to be more specialized in comparison to the typical subspecies. It grows exclusively in rock crevices, while *D. senilis* has a wider range of edaphic specialization and occupies different types of stony and sandy substrata (e.g., rocks, stony slopes, sandy and pebbly banks, bottoms of dried spring streams). No principal differences are observed in the altitudinal ranges of the two subspecies (1500–2200 m in *D. senilis* subsp. *gubanovii* and 300–2200 m in *D. senilis* s. str.). Geographically, the new subspecies is endemic to a small area between 48°–49°40′N and 90°–91°40′E. According to the widely accepted botanical-geographical subdivision of Mongolia (Grubov & Yunatov, 1952), this territory includes the southeastern part of the Khobdo region, the extreme northwestern portion of the Great

Lakes Depression, and adjacent northeastern districts of the Mongolian Altai. Thus, *D. senilis* subsp. *gubanovii* occurs at the northwestern limit of the distribution area of *D. senilis* s.l., which is common in the desert regions of Mongolia and neighboring China and also known from the two localities in southern Siberia at the border with Mongolia. Both subspecies are sympatric through the distribution range of the newly described subspecies; however, *D. senilis* subsp. *gubanovii* has its own distribution pattern, which in combination with minor but consistent morphological and ecological differences, justifies the recognition of the new taxon at the subspecies rank.

Etymology. *Dontostemon senilis* subsp. *gubanovii* is named in memory of Ivan Alexeyevich Gubanov, one of the leading experts in the flora of Mongolia and collector of the holotype.

Paratypes. MONGOLIA. Bayan-Ulgiy aimak, 13 km NE of Altan-Tsurts, Khulstyn-Khutel pass, 21 July 1979, *Z. V. Karamysheva, I. Yu. Sumerina, U. Beket & H. Buyan-Orshikh s.n.* (LE); Khobdo aimak, E slope of Mongolian Altai, 1 km S of Khobdo airport, 25 Aug. 1984, *I. A. Gubanov 9042* (MW); Mongolian Altai, N part of Achit-Nuur depression, 20 km E of Bukhen-Muren (Ubsunuur aimak), 7 Aug. 1988, *R. V. Kamelin & I. A. Gubanov s.n.* (MW); Khobdo aimak, 5 km NE of Khobdo, 21 May 2002, *S. Smirnov, D. German, S. Dyachenko & P. Kosachev s.n.* (ALTB); Khongo-gol valley, 22 May 2002, *S. Smirnov, D. German, S. Dyachenko & P. Kosachev s.n.* (ALTB); Bayan-Ulgiy aimak, 5 km NE of Bayan-Ulgiy, 23 June 2003, *D. German s.n.* (ALTB).

The Taxonomic Status of *Dontostemon intermedius*

Dontostemon intermedius Voroschilov, Bull. Gen. Bot. Garden (Moscow) 72: 36. 1972. TYPE: [Russia, Far East]: Primorsky Prov. (Krai), Tetyukhe Distr., Sinachinsky pass, 1000 m, limestone, 20 Sep. 1969, *V. Voroschilov & V. Dvorakovskaya s.n.* (holotype, MHA).

The status of *Dontostemon intermedius*, endemic to the southern part of the Russian Far East, needs some elucidation. It was accepted as a species in Voroschilov (1972, 1982), Golubkova (1974b), and Berkutenko (1988), not included in Al-Shehbaz and Ohba (2000), and reduced to synonymy of *D. dentatus* by Zhou et al. (2001). A study of its type and additional collections reveals that it is in fact closer to *D. dentatus* than to any other species of the genus, but it can be distinguished from the latter species as follows.

1a. Upper part of stem and pedicels uniformly puberulent with minute twisted simple trichomes, sometimes glabrescent; sepals with straight and distinctly longer simple trichomes. All leaves (rarely with exception of the uppermost ones) dentate or denticulate. Siliques suberect to ascending . . . . . *D. dentatus* (Bunge) Ledebour

1b. Upper part of stem, pedicels, and sepals pubescent with a mixture of minute twisted simple trichomes and sessile glands; simple trichomes on sepals equal in size and shape to those on stem and pedicels. Leaves predominantly entire (rarely with occasional teeth on some leaves). Siliques divaricate-ascending to horizontally reflexed . . . . . *D. intermedius* Voroschilov

The above differences demonstrate the distinctness of *Dontostemon intermedius* and argue against its treatment as a glandular variety of *D. dentatus*. This conclusion is supported by the fact that glandular trichomes in *D. intermedius* are concentrated mostly on the upper part of the plant but are totally absent on the fruits, while in the glandular variety of the related *D. integrifolius* (L.) C. A. Meyer the glands are dispersed more or less uniformly on all parts of the plant, including siliques and the lower portion of stems. Therefore, it seems wise to recognize *D. intermedius* as a distinct species.

Additional specimen examined. [RUSSIA, Far East], Primorsky Prov. (Krai), Tetyukhe Distr., 10 km N of Tetyukhe, *V. N. Voroshilov 67* (MHA).

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Nomenclatural Changes in *Cucumis* (Cucurbitaceae)

Amanuel G. Ghebretinsae
Department of Biology, Saint Louis University, 3507 Laclede Avenue, St. Louis, Missouri 63103, U.S.A. ghebreag@slu.edu

Mats Thulin
Department of Systematic Botany, Uppsala University, Norbyvägen 18D, SE-752 36 Uppsala, Sweden. mats.thulin@ebc.uu.se

Janet C. Barber
Department of Biology, Saint Louis University, 3507 Laclede Avenue, St. Louis, Missouri 63103, U.S.A. barberjc@slu.edu

Abstract. Recent studies show that the genus *Cucumis* L. in its current sense is paraphyletic, with *Cucumella* Chiovenda, *Dicaelospermum* C. B. Clarke, *Mukia* Arnott, *Myrmecosicyos* C. Jeffrey, and *Oreosyce* Hooker f. nested within it. A proposal to expand *Cucumis* to include these nested genera has therefore been made. In this paper the nomenclatural changes that are needed to accommodate the currently recognized taxa of the nested genera in *Cucumis* are made. The following new combinations and new names are proposed: *Cucumis aetheocarpus* (C. Jeffrey) Ghebretinsae & Thulin, *C. bryoniifolius* (Merxmüller) Ghebretinsae & Thulin, *C. cinereus* (Cogniaux) Ghebretinsae & Thulin, *C. clavipetiolatus* (J. H. Kirkbride) Ghebretinsae & Thulin, *C. engleri* (Gilg) Ghebretinsae & Thulin, *C. gracilis* (W. S. Kurz) Ghebretinsae & Thulin, the new name *C. indicus* Ghebretinsae & Thulin, *C. javanicus* (Miquel) Ghebretinsae & Thulin, *C. kelleri* (Cogniaux) Ghebretinsae & Thulin, the new name *C. kirkbridei* Ghebretinsae & Thulin, *C. leiospermus* (Wight & Arnott) Ghebretinsae & Thulin, *C. messorius* (C. Jeffrey) Ghebretinsae & Thulin, *C. reticulatus* (A. Fernandes & R. Fernandes) Ghebretinsae & Thulin, *C. ritchiei* (C. B. Clarke) Ghebretinsae & Thulin, and *C. silentvalleyi* (Manilal, T. Sabu & P. J. Mathew) Ghebretinsae & Thulin.

Key words: *Cucumella*, *Cucumis*, Cucurbitaceae, *Dicaelospermum*, *Mukia*, *Myrmecosicyos*, *Oreosyce*.

The genus *Cucumis* L. belongs to the Cucurbitaceae subfamily Cucurbitoideae and is currently placed in the tribe Benincaseae (Jeffrey, 2005; Kocyan et al., 2007). In the latest revision of the genus (Kirkbride, 1993), 32 species were recognized, and since then one further species has been described (Thulin & Al-Gifri, 1994), making the total number 33. In a paper on the molecular phylogenetics of *Cucumis* and related genera (Ghebretinsae et al., in prep.), it was demonstrated that *Cucumis* sensu Kirkbride is paraphyletic, and *Cucumella* Chiovenda, *Dicaelospermum* C. B. Clarke, *Mukia* Arnott, *Myrmecosicyos* C. Jeffrey, and *Oreosyce* Hooker f. were nested with strong support within *Cucumis*. Thirty-eight ingroup taxa were sampled for the study, including 30 species of *Cucumis*, four species of *Cucumella*, two species of *Mukia*, one species of *Oreosyce*, and one species of *Dicaelospermum*. All currently recognized infrageneric taxa were represented, and subspecies and varieties of individual species were sampled wherever possible, resulting in a total of 45 accessions, and both nuclear (ITS) and chloroplast (*trnS-trnG*) sequences were used. Ghebretinsae et al. (in prep.) therefore proposed that the genus *Cucumis* be expanded to include all these nested genera, but no formal nomenclatural changes were made.

As proposed herein, a newly circumscribed *Cucumis* increases to 52 species from a previous 33 species. Similarities in pollen morphology, such as oblate-suboblate pollen grains, were already noted for *Cucumis* and all the nested segregates by Marticorena (1963). In this paper we present the nomenclatural changes that are needed to accommodate the nested genera in the expanded *Cucumis*. New combinations are proposed for 13 species, and new names are proposed for two species. The circumscriptions of species previously placed in *Cucumella* follow Kirkbride (1994), and the taxa previously placed in *Mukia* are circumscribed in accordance with De Wilde and Duyfjes (2006).

1. **Cucumis aetheocarpus** (C. Jeffrey) Ghebretinsae & Thulin, comb. nov. Basionym: *Cucumella*

aetheocarpa C. Jeffrey, Kew Bull. 19: 215. 1965. TYPE: Tanzania. Tunduru Distr.: Tunduru–Masasi rd., 5 Mar. 1963, *M. Richards 17751* (holotype, K; isotypes, LISC not seen, SRGH not seen).

2. Cucumis bryoniifolius (Merxmüller) Ghebretinsae & Thulin, comb. nov. Basionym: *Hymenosicyos bryoniifolia* Merxmüller, Mitt. Bot. Staatssamml. München 6: 205. 1953. *Cucumella bryoniifolia* (Merxmüller) C. Jeffrey, Kew Bull. 15: 350. 1962. TYPE: Zimbabwe. Rusape, Aug. 1952, *G. Dehn R25* (holotype, M not seen; isotype, SRGH not seen).

3. Cucumis cinereus (Cogniaux) Ghebretinsae & Thulin, comb. nov. Basionym: *Kedrostis cinerea* Cogniaux, Bull. Herb. Boissier, sér. 2, 1: 883. 1901. *Cucumella cinerea* (Cogniaux) C. Jeffrey, Kew Bull. 15: 350. 1962. TYPE: Namibia. Giftkopje, Hereroland, 12 Feb. 1900, *K. Dinter 1440* (holotype, Z not seen; isotype, BR not seen).

4. Cucumis clavipetiolatus (J. H. Kirkbride) Ghebretinsae & Thulin, comb. nov. Basionym: *Cucumella clavipetiolata* J. H. Kirkbride, Brittonia 46: 178. 1994. TYPE: Namibia. Omaruru Distr.: Brandberg, Orabeswand, 3 Apr. 1964, *B. Nordenstam 3657* (holotype, S; isotype, M not seen).

5. Cucumis engleri (Gilg) Ghebretinsae & Thulin, comb. nov. Basionym: *Kedrostis engleri* Gilg, Bot. Jahrb. Syst. 34: 359. 1904. *Cucumella engleri* (Gilg) C. Jeffrey, Kew Bull. 15: 350. 1962. TYPE: Kenya. Nakuru-See, 30 Aug. 1902, *A. Engler 1992* (lectotype, designated by Kirkbride, 1994: 182, BR not seen).

6. Cucumis gracilis (W. S. Kurz) Ghebretinsae & Thulin, comb. et stat. nov. Basionym: *Mukia maderaspatana* (L.) M. Roemer var. *gracilis* W. S. Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 46: 104. 1877. *Mukia gracilis* (W. S. Kurz) W. J. de Wilde & Duyfjes, Thai Forest Bull., Bot. 34: 40. 2006. TYPE: Burma. Pagamew, *N. Wallich 6714* (holotype, CAL not seen; isotype, K-W not seen).

7. Cucumis indicus Ghebretinsae & Thulin, nom. nov. Replaced name: *Melothria ritchiei* Chakravarty, J. Bombay Nat. Hist. Soc. 50: 898. 1952. *Cucumella ritchiei* (Chakravarty) C. Jeffrey, Kew Bull. 19: 215. 1965, non *Cucumis ritchiei* (C. B. Clarke) Ghebretinsae & Thulin. TYPE: India. Bombay Presidency, Savantvadi State, Ram Ghat, *D. Ritchie 67* (holotype, E not seen).

With the transfer herein of *Dicaelospermum ritchiei* C. B. Clarke to *Cucumis*, its epithet is occupied within the genus by the prior name by Clarke (1879). A new name was therefore necessary with the transfer of *Melothria ritchiei* Chakravarty (1952) to *Cucumis*. The new name "indicus" refers to the type locality in India.

8. Cucumis javanicus (Miquel) Ghebretinsae & Thulin, comb. nov. Basionym: *Karivia javanica* Miquel, Fl. Ned. Ind. 1: 661. 1856. *Mukia javanica* (Miquel) C. Jeffrey, Hooker's Icon. Pl. 37: 3, tab. 3661. 1969. TYPE: Java. *T. Horsfield s.n.* (holotype, U not seen; isotypes, BM, K).

9. Cucumis kelleri (Cogniaux) Ghebretinsae & Thulin, comb. nov. Basionym: *Oreosyce kelleri* Cogniaux, Bull. Herb. Boissier 4: 822. 1896. *Cucumella kelleri* (Cogniaux) C. Jeffrey, Kew Bull. 15: 350. 1962. TYPE: Ethiopia. Abdallah, 1891, *A. Keller 111* (holotype, Z not seen).

10. Cucumis kirkbridei Ghebretinsae & Thulin, nom. nov. Replaced name: *Cucumella jeffreyana* J. H. Kirkbride, Brittonia 46: 168. 1994, non *Cucumis jeffreyanus* Thulin, Nordic J. Bot. 11: 539. 1991. TYPE: Uganda. Oct. 1929, *L. C. C. Liebenberg 954* (holotype, K).

When *Cucumella jeffreyana* J. H. Kirkbride is tranferred to *Cucumis*, the epithet is occupied by Thulin's 1991 name. Thus a new name is required, and our choice honors Joseph Harold Kirkbride (1943–) for his wealth of experience within the Cucurbitaceae.

11. Cucumis leiospermus (Wight & Arnott) Ghebretinsae & Thulin, comb. nov. Basionym: *Bryonia leiosperma* Wight & Arnott, Prodr. Fl. Ind. Orient. 1: 345. 1834. *Mukia leiosperma* (Wight & Arnott) Wight, Ann. Mag. Nat. Hist. 8: 268. 1842. TYPE: India. Madras, Palni Hills, *R. Wight 1112* (lectotype, designated by Jeffrey, 1969: 9, tab. 3663, K; isotype, BR not seen).

12. Cucumis messorius (C. Jeffrey) Ghebretinsae & Thulin, comb. nov. Basionym: *Myrmecosicyos messorius* C. Jeffrey, Kew Bull. 15: 357. 1962. TYPE: Kenya. Nakuru Distr.: Elmenteita, Soysambu Estate, *A. V. Bogdan 980* (holotype, K; isotype, EA not seen).

13. Cucumis reticulatus (A. Fernandes & R. Fernandes) Ghebretinsae & Thulin, comb. nov. Basionym: *Cucumella reticulata* A. Fer-

nandes & R. Fernandes, Bol. Soc. Brot., ser. 2, 43: 307. 1969. TYPE: Angola. Moxico: betw. Mumbala River & Namavumba River, 9 Jan. 1938, *E. Milne-Redhead 4012* (holotype, K; isotype, BM).

14. **Cucumis ritchiei** (C. B. Clarke) Ghebretinsae & Thulin, comb. nov. Basionym: *Dicaelospermum ritchiei* C. B. Clarke, Fl. Brit. India (J. D. Hooker) 2: 630. 1879. *Mukia ritchiei* (C. B. Clarke) W. J. de Wilde & Duyfjes, Thai Forest Bull., Bot. 34: 45. 2006. TYPE: India, *D. Ritchie s.n.* (holotype, K).

15. **Cucumis silentvalleyi** (Manilal, T. Sabu & P. J. Mathew) Ghebretinsae & Thulin, comb. nov. Basionym: *Cucumella silentvalleyi* Manilal, T. Sabu & P. J. Mathew, Acta Bot. Indica 13: 283. 1985. TYPE: India. Kerala: Palghat Distr., Silent Valley, Poochapara, 20 Oct. 1982, *T. Sabu SV10662* (holotype, CAL not seen; isotypes, CALI not seen, K, MH not seen).

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Astragalus darwinianus (Leguminosae, Galegeae), a New Species from Argentina

Edith Gómez-Sosa

Instituto de Botánica Darwinion, CC 22, B 1642HYD San Isidro, Argentina.
egomez-sosa@darwin.edu.ar

Abstract. *Astragalus darwinianus* Gómez-Sosa, a new endemic species (Leguminoseae, Galegeae) from the south of Argentina, is described, illustrated, and compared with the morphologically similar *A. patagonicus* (Philippi) Spegazzini based on vegetative characteristics and with *A. mendocinus* Gómez-Sosa based on fruit morphology. The new entity has decumbent stems, racemes that are (2)3- to 4-flowered, and legumes that are unilocular, incurved, and incanous pubescent.

Resumen. *Astragalus darwinianus* Gómez-Sosa, una nueva especie endémica del sur de Argentina, se describe, ilustra y se compara con *A. patagonicus* (Philippi) Spegazzini con las que comparte características vegetativas y con *A. mendocinus* Gómez-Sosa similares por la morfología del fruto. El nuevo ejemplar tiene tallos decumbentes, racimos con (2)3–4 flores, legumbre unilocular, incurva e incano pubescente.

Key words: Argentina, *Astragalus*, Galegeae, Leguminosae, Patagonia.

The genus *Astragalus* L. (Leguminosae, Galegeae) in South America is represented by approximately 110 species found in Ecuador, Peru, Bolivia, Chile, Uruguay, and Argentina, as presently revised (Gómez-Sosa, 1979, 1999). In Argentina there are about 70 species from the north, in the province of Jujuy, to the south in the province of Tierra del Fuego. It inhabits the western areas from the Andean mountains at about 4700 m altitude, extending to the southeast along the Atlantic coast in Patagonia (Gómez-Sosa, 2005). The contribution presented here is relevant to the Patagonian region with 29 species (Gómez-Sosa, 1984).

Astragalus darwinianus Gómez-Sosa, sp. nov. TYPE: Argentina. Santa Cruz, Dpto. Lago Argentino: 30 km E of Calafate, near Santa Cruz river, 190 m, 50°15′47″S, 071°53′10″W, 21 Dec. 2002, *D. Benjamini 911* (holotype, SI; isotypes, CTES, MO). Figure 1.

Herba prostrata, caulibus decumbentibus; stipulae amplexicaules, bidentatae, glabrae, ciliatae; folia 4–6 cm longa, petiolo 2–3 cm incluso; foliola 9 ad 11, linearia vel elliptica, 8–10 × 1.5–2.5 mm, supra glabra, subtus alba strigoso-pubescentia, in rachidi 0.8 cm distantia, conduplicata, apice obtuso; racemi laxi (2)3- ad 4-flori; pedunculi quam folia aequilongi; flores (0.5–)0.7–1 cm pedicellati, erecti ad ascendentes, calyx campanulatus, 2-bracteolatus; vexillum 1.25 × 1 cm; legumen immaturum, ca. 3 × 0.25 cm, fusiforme, lunate incurvum, uniloculare, papyraceum, apiculatum, marginibus fusiformibus, incane pubescens, lateraliter compressum et lineare in transectione.

Prostrate caulescent herb; stems 2–4 cm; stipules membranous, connate and amplexicaulous into a shortly bidentate sheath, glabrous, ciliate. Leaves 4–6 cm, including petiole 2–3 cm; leaflets 9 to 11, distant by nearly 0.8 cm on the rachis, in outline linear or elliptic, obtuse, 8–10 × 1.5–2.5 mm, glabrous above, white strigose-pubescent below. Racemes loosely (2)3- to 4-flowered; peduncles 4–5.5(–6) cm, decumbent in age; bracts 2.5 mm, subulate, glabrous, ciliolate; bracteoles 2, 1.2 mm. Flowers blue-violet to pale blue, pedicels (0.5–)0.7–1 cm, erect to ascending; calyx 7.5 cm, canescent, tube campanulate 4 mm, teeth subulate 3.5 mm; banner 1.25 × 1 cm, erect, obtuse; wings 1.25 × 0.25 cm, with the claws included, narrowly rectangular; keel 1.15 cm; ovary substipitate, pubescent, style glabrous, stigma capitate; ovules ca. 28. Pod immature, canescent, ca. 3 × 0.25 cm, fusiform, papery, incurved throughout for ca. 1/6–1/3 of a circle, the stipe concealed in the hypanthial cup, unilocular, not inflexed, papery, carinate dorsally, laterally compressed and linear in cross section.

Etymology. This species is dedicated to Charles Darwin (1809–1882) who, at 22 years of age, was invited by Captain R. FitzRoy to travel on the *Beagle* around the world as the naturalist on the voyage. Darwin's longest stay on land was in the region around and south of the La Plata River, Brazil, Uruguay, and Argentina (this included Patagonia and Tierra del Fuego), where he explored for 20 months and six days, from 26 July 1832 to 2 April 1834. On 16 April 1834, along the coast of Argentine Patagonia, the *Beagle*

Figure 1. *Astragalus darwinianus* Gómez-Sosa. —A. Plant habit. —B. Stipules. —C. Leaflets, conduplicate, abaxial view. —D. Leaflets, conduplicate, adaxial view. —E. Inflorescence. —F. Calyx. —G. Teeth, internal view. —H. Banner, internal view. —I. Banner, lateral view. —J. Wing. —K. Keel. —L. Ovary. —M. Androecium. —N. Fruit, lateral view. —O. Fruit, transection. Based on *Benjamini 911* (holotype, SI).

Table 1. Comparison of *Astragalus darwinianus* and morphologically similar species.

	A. darwinianus	*A. patagonicus*	*A. mendocinus*
Stem length (cm)	2–4, decumbent	1–15, decumbent	8–12, procumbent
Leaf length (cm)	4–6	(3–)4–10(–13)	5.5–7
Leaflet number	9 to 11	(7)9 to 11(13)	8 to 10
Flowers, number per raceme	(2)3 to 4	4 to 6(8)	4 to 6
Banner	obtuse	emarginate	emarginate
Pedicel length (cm)	(0.5–)0.7–1	0.1–0.15	0.25–0.3
Legume	unilocular (immature), 3 × 0.25 cm, papery valves, canescent, incurved throughout nearly 1/6–1/3 of a circle	unilocular, 2.5–3 × 1–1.25 cm, coriaceous valves, mottled, oblong to ovoid	sub-bilocular, 4 × 0.35 cm, papery valves, glabrous, transversely venulose incurved throughout nearly 3/4 of a circle.

anchored at the mouth of the Santa Cruz River and, on 18 April, an excursion started up the Santa Cruz River "as far as time would allow" toward the Andes (Parodiz, 1981: 35). Darwin was the first botanist to explore this area, according to D. M. Moore in his contribution discussing the early exploration of Austral Patagonia (Boelcke et al., 1985).

Habitat. *Astragalus darwinianus* is known from only the type specimen. It occurs in the south of the Argentinian Patagonian region near the Santa Cruz River, growing on sand with stones. In this area the Patagonian vegetation is named "santacrucense"; the phytogeographic area is known as the Central District or "Erial Patagónico" (Correa, 1998: 135–138). *Astragalus darwinianus* may be found among communities of nanophanerophytes. Plant associates include: *Petunia patagonica* (Spegazzini) Millan, *Nassauvia glomerulosa* D. Don, *Acaena platyacantha* Spegazzini, *Adesmia ameghinoi* Spegazzini, and *Astragalus patagonicus* (Philippi) Spegazzini and *A. palenae* (Philippi) Reiche.

Affinities. In the Argentinian Patagonia flora, *Astragalus darwinianus* appears vegetatively similar to *A. patagonicus* (Johnston, 1947; Gómez-Sosa, 1979, with map included). Its incurved pod resembles *A. mendocinus* Gómez-Sosa (Gómez-Sosa, 1988). The new species is markedly set apart from both of these species by the number of flowers per raceme and fruit morphology (Table 1).

Acknowledgments. I thank Dubi Benjamini, the collector of this novel plant, which was found among Leguminosae specimens received from him as a gift for identification. Since 1991, he has been an enthusiastic collector of the South American butterfly *Lycaenidae* (Lepidoptera). He has a particular interest in plants of *Astragalus* and their identification to species, because the genus *Pseudolucia* Nabokov oviposits and develops only on fruits of certain species of *Astragalus*. I am also grateful to Michael Sanderson and Jeffrey White for critical review of the present work, to Victoria C. Hollowell for offering careful suggestions toward its revision, to Francisco Rojas for the drawing, and to Jan Saunders for reviewing the English version.

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New Species and Combinations in *Physaria* (Brassicaceae) from Western North America

Ben R. Grady and Steve L. O'Kane Jr.
Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50614-0421, U.S.A.
brgrady@wisc.edu; author for correspondence: steve.okane@uni.edu

ABSTRACT. Three new species of *Physaria* (Nuttall) A. Gray from the western United States are described and illustrated: *P. eriocarpa* Grady & O'Kane, *P. pachyphylla* O'Kane & Grady, and *P. pycnantha* Grady & O'Kane. *Physaria curvipes* (A. Nelson) Grady & O'Kane and *P. spatulata* (Rydberg) Grady & O'Kane are proposed as new combinations in the genus and are provided with updated descriptions. Taxonomic changes are the product of a molecular study of these species and others formerly allied with *P. reediana* O'Kane & Al-Shehbaz (= *Lesquerella alpina* (Nuttall) Watson). A key is provided that includes the species described here as well as other central Rocky Mountain species traditionally affiliated with *P. reediana*.

Key words: Brassicaceae, Canada, *Lesquerella*, *Physaria*, United States.

The taxonomy of the species in the genus *Physaria* (Nuttall) A. Gray (which includes most of the species formerly included in *Lesquerella* S. Watson) has undergone revision several times over the past century (Payson, 1921 [1922]; Rollins & Shaw, 1973; Rollins, 1993; Al-Shehbaz & O'Kane, 2002). Some species groups within the genus have been especially problematic. Species historically associated with *P. reediana* O'Kane & Al-Shehbaz (= *Lesquerella alpina* (Nuttall) Watson) are one such group. In the past, one polymorphic species or as many as seven species have been informally included in the *P. reediana* species complex (Rollins & Shaw, 1973). Recently, a molecular analysis of the evolutionary history of this difficult group of species was performed to clarify its relationships and taxonomy (Grady, 2005). The presence of more taxa than formerly recognized in this complex is not surprising. The genus *Physaria* is speciose in the western United States and contains many local and edaphic endemics (Rollins & Shaw, 1973). Since Rollins' (1993) treatment of the Brassicaceae in North America, seven new species of *Physaria* have been discovered in the western United States (e.g., Rollins, 1995; Rollins et al., 1995; Anderson et al., 1997; O'Kane, 1999; O'Kane & Reveal, 2006). We propose three additional new species and two new combinations in *Physaria* based on field, herbarium, and molecular studies.

KEY TO THE NORTH AMERICAN SPECIES PREVIOUSLY OR CURRENTLY ASSOCIATED WITH *PHYSARIA REEDIANA*

1a. Rays of trichomes closely appressed to surface of mature silicle.
  2a. All basal leaves linear, 1–1.5 mm wide; north-central Colorado and the Uinta Mtns. of Utah and Wyoming . . . . . *P. parvula* (Greene) O'Kane & Al-Shehbaz
  2b. Basal leaves spathulate to orbicular or rhombic in outline, wider than 2 mm, to 8 mm.
    3a. Basal leaves rhombic in outline, leaf blade distinct from petiole, almost always folded; silicles as wide as long (2–4 mm), styles to 2 mm, shorter than mature silicles; northwest Colorado, northeast Utah, and southwest Wyoming . . . . . *P. subumbellata* (Rollins) O'Kane & Al-Shehbaz
    3b. Basal leaves spathulate to nearly orbicular in outline, not folded; silicles larger (3.5 mm or greater), usually longer than wide; distribution elsewhere.
      4a. Styles noticeably longer than silicles; plants caespitose, fruiting stems to 5 cm, never more than 2 × longer than basal leaves; basal leaves mostly narrowly oblanceolate, blade gradually narrowed to petiole; northern Colorado and southwest Nebraska, then northwest through central Wyoming . . . . . *P. reediana* (Nuttall ex Torrey & A. Gray) O'Kane & Al-Shehbaz
      4b. Styles to 6 mm, roughly equal to or shorter than length of silicles; plants loose, not caespitose, fruiting stems to 24 cm, often much longer than basal leaves; blade abruptly narrowed to petiole in outer basal leaves.
        5a. Fruiting pedicels curved; basal leaves nearly 1 mm thick, blades cupped; silicles globose with acute apices, densely covered by trichomes; Pryor Mtn. desert of south-central Montana . . . . . 3. *P. pachyphylla* O'Kane & Grady
        5b. Fruiting pedicels sharply sigmoid; basal leaves not thickened, blades flat; silicles ellipsoid with acute apices, sparsely covered by trichomes.
          6a. Fruiting pedicels 2 × long or longer (10–20 mm) than mature silicles; styles ± equal to silicles in length, to 6 mm; plants widespread, from western Nebraska and Wyoming

northward to southern Alberta and Saskatchewan . .5. *P. spatulata* (Rydberg) Grady & O'Kane

6b. Fruiting pedicels less than 2 × length (4–7 mm) of mature silicles; styles shorter than mature silicles (1.5–2.5 mm long); plants limited to the Big Horn Mtns., Wyoming and Montana . . . . . 1. *P. curvipes* (A. Nelson) Grady & O'Kane

1b. Rays of trichomes long (up to 0.5 mm), erect or ascending, giving the mature silicles a shaggy appearance.

7a. Basal leaves narrowly obovate to suborbicular, folded, blade abruptly narrowed to petiole; caudex thickened, ± 1 cm; Sheep Mtn. in the Pioneer Range of southwest Montana . . . . . 2. *P. eriocarpa* Grady & O'Kane

7b. Basal leaves linear to oblanceolate, no distinction between blade and petiole; caudex narrow, only to 5 mm width; distribution elsewhere.

8a. Styles longer than mature silicles, to 4 mm; fruiting stems never exceeding basal leaves; trichomes once bifurcate, not fused near base; southwest Wyoming. . . . . .*P. nelsonii* (A. Nelson) O'Kane & Al-Shebaz

8b. Styles shorter than silicles, only to 3 mm; fruiting stems often longer than basal leaves, to 7 cm; trichomes twice bifurcate, fused less than 10% of ray length at base; east-central Idaho and southwest Montana . . . . . 4. *P. pycnantha* Grady & O'Kane

1. Physaria curvipes (A. Nelson) Grady & O'Kane, comb. nov. Basionym: *Lesquerella curvipes* A. Nelson, Bull. Torrey Bot. Club 25: 205. 1898. TYPE: U.S.A. Wyoming: Dome Lake Grade, *A. Nelson 2424* (holotype, RM; isotypes, GH, NY). Figure 1.

Loosely spreading perennial; caudices singular, 2–3 mm diam.; stems usually decumbent, well exserted beyond basal leaves, 8–24 cm, often red-purple in color. Basal leaves erect, spathulate to nearly rhombic, 25–50(–90) × 2–4(–6) mm, blade gradually narrowed to the petiole; leaves covered by stellate trichomes, 0.3 mm diam., 4 or 5 main rays, once to twice bifurcate, slightly fused near bases, tuberculate, 16 to 24 terminal rays, closely appressed to leaf surfaces; cauline leaves few, spathulate. Inflorescence racemose, pedicels curved-ascending to sigmoid, 4–7 mm. Sepals pale yellow, 3.5–4 mm, pubescent; petals yellow, ligulate, 4–6 mm; ovules 2 to 4 per locule; styles glabrous, 1.5–2.5 mm. Silicles ellipsoid, not inflated, strongly flattened parallel to the septum, apical constriction evident, (3–)5–9 mm × 2–4 mm; silicle trichomes closely appressed to surface, valve interiors glabrous; styles never more than half of the length of the mature silicles.

Physaria curvipes (curved bladderpod) was first recognized by Aven Nelson in 1898 as *Lesquerella curvipes* A. Nelson. Rollins and Shaw (1973) thought that this species represented a form of the highly variable *L. alpina* subsp. *alpina* (Nuttall) Rollins & Shaw, and thus *L. curvipes* was reduced to synonomy. The close relationship of *P. curvipes* and *P. reediana* is apparent from recent molecular work (Grady, 2005). Morphologically, *P. curvipes* is distinct from *P. reediana*, and their primary ranges do not overlap.

Physaria curvipes is a perennial species, endemic to the Big Horn Mountains in Wyoming and Montana (Fig. 2). Like many other members of the genus, it is associated with soils derived from limestone parent material and can inhabit areas of high solar intensity (pers. obs.). The species has a broad elevation range of 1650–2775 m above sea level. It is interesting to note the loose growth form of *P. curvipes* present at such elevations, because other members of the genus, e.g., *P. humilis* (Rollins) O'Kane & Al-Shehbaz, occurring at the upper end of this elevation gradient are typically densely caespitose.

Physaria curvipes can be distinguished from *P. reediana* by silicle, pedicel, and basal leaf shape, as well as growth form. *Physaria curvipes* has silicles that are larger (usually 5–9 mm) and strongly flattened parallel to the septum (Fig. 1), whereas the silicles of *P. reediana* are smaller (3.5–5 mm) and are nearly terete. The fruiting pedicels of *P. curvipes* are often sharply sigmoid, while the pedicels of *P. reediana* are curved-ascending. *Physaria curvipes* has basal leaves that are narrowly spathulate to nearly rhombic (to 90 mm long) and a loose growth habit; *Physaria reediana* has basal leaves that are lanceolate in outline and has a more compact growth form. *Physaria curvipes* is limited to the Big Horn Mountains in north-central Wyoming and south-central Montana. *Physaria reediana* can be found in northwest Nebraska, north-central Colorado, and southeast and central Wyoming, in the United States.

Physaria curvipes superficially resembles *P. spatulata* (Rydberg) Grady & O'Kane, but the two species are not directly related. Both taxa exhibit loose growth forms and sigmoid-curved fruiting pedicels. They can best be differentiated by fruiting pedicel length and style length. *Physaria curvipes* has pedicels that range from 4–7 mm in length, while the pedicels of *P. spatulata* are longer, ranging from 10–20 mm. The styles of *P. curvipes* are never more than half the length of mature silicles, while the styles of *P. spatulata* are often equal to the length of the mature silicles. The silicles of *P. curvipes* are larger (usually 5–9 mm) and more flattened than those of *P. spatulata*. Thus, in *P. curvipes* the pedicels are 4–7 mm and less than two times longer than the silicles, while in *P. spatulata* the pedicels are 10–20 mm and

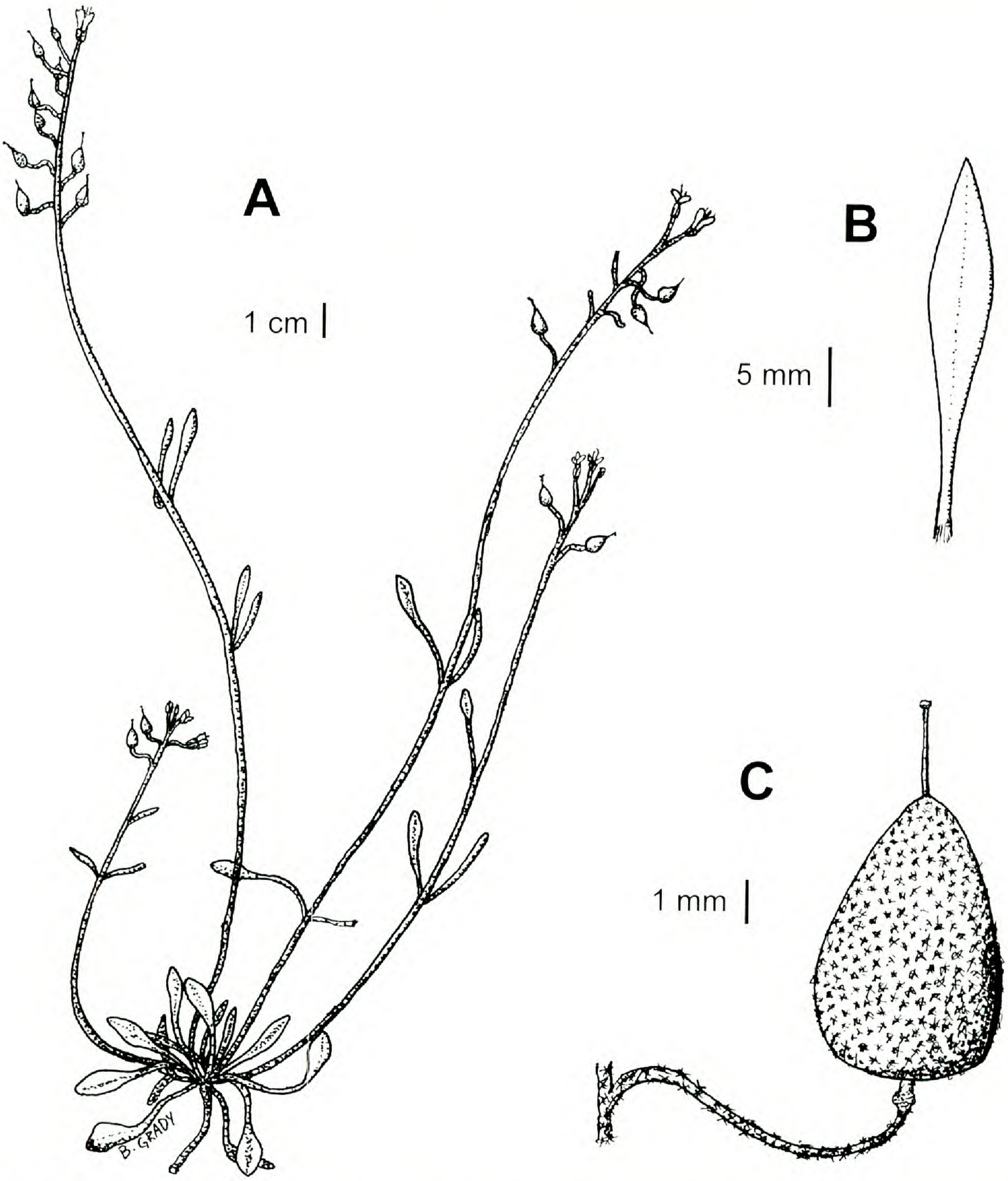

Figure 1. *Physaria curvipes* (A. Nelson) Grady & O'Kane. —A. Plant (pressed). —B. Basal leaf. —C. Silicle and fruiting pedicel. Drawn from *Dueholm 6667* (NY).

over two times longer than the silicles. The combination of short pedicels, short styles, and large silicles gives the infructescences of *P. curvipes* a distinct appearance compared to those of *P. spatulata*.

Representative specimens examined. U.S.A. **Montana:** Big Horn Co., Big Horn Mtns., limestone gravelly soil on Big Horn divide ca. 1 mi. S of Windy Point Lookout, *P. Lesica 1029* (MONTU). **Wyoming**: Sheridan Co., 8 mi. E of Wyarno, *Dueholm 6667* (NY); Sheridan Co., 6 mi. W of Dayton on Hwy. 14, steep shaley, limy roadcut in ponderosa pine zone, Amsden Formation, *S. L. O'Kane Jr. & B. R. Grady 7903* (GH, ISTC, MO); Big Horn Mtns. at summit of Forest Rd. 144, NE of Baldy Pass, alpine meadow, cobbley-gravelly soil of white limestone on windy ridge, *S. L. O'Kane Jr. & B. R. Grady 7905* (GH, ISTC, MO, NY, RM); steep hillside near the mouth of Big Goose Canyon, E base of the Big Horn Mtns., *R. C. Rollins 443* (GH); Dayton Grade, ca. 6 mi. W of Dayton, steep loose limy bank, *R. C. Rollins 57181* (B, BM, CS); Big Horn Co., limestone benches overlooking Big Horn Valley, turnout in US Hwy. 14A, SW of summit of Limestone Mtn., *B. C. Johnston & P. Lucas 1839* (COLO); Big Horn Mtns., 13.8 mi. E of Shell on Hwy. 14 in Shell Creek Canyon, steep limy roadcut, *B. R. Grady 68* (ISTC, MO, RM).

2. Physaria eriocarpa Grady & O'Kane, sp. nov. TYPE: U.S.A. Montana: Beaverhead Co., ridgeline betw. Sheep Mtn. & Black Lion Mtn., windswept ridge at limber pine krummholz, vegetation sparse & mostly mat-forming, pure

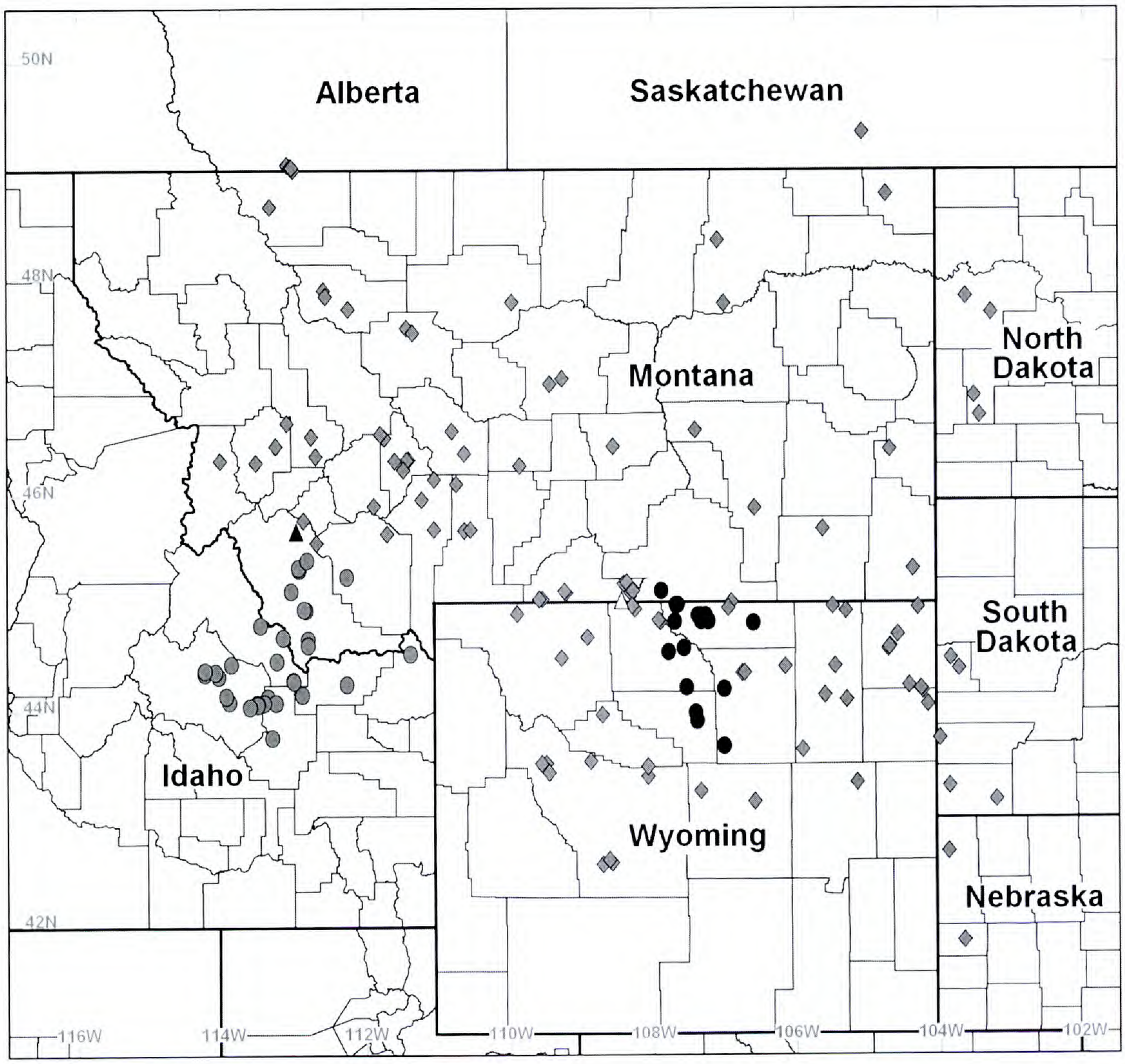

Figure 2. Distribution of new species and combinations of *Physaria* presented here: *P. curvipes* (black circle), *P. eriocarpa* (black triangle), *P. pachyphylla* (white triangle), *P. pycnantha* (gray circle), and *P. spatulata* (gray diamond).

white limestone gravel & cobbles, 8700 ft., 23 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7927* (holotype, GH; isotypes, BRY, COLO, ISTC, MO, MONT, MONTU, NY, RM, UTC). Figure 3.

Haec species ad *Physariam nelsonii* (A. Nelson) O'Kane & Al-Shebaz maxime accedit, sed ab ea foliorum basalium lamina obovata orbicularive valde plicata ex petiolo distincta, caule fructifero ex foliis basalibus bene exserto atque siliqua ovoidea ellipsoideave distinguitur.

Long-lived perennial, caespitose, caudex thickened, (4–)8–11 mm, branched; stems well exserted beyond basal leaves, 3.5–9(–12) cm long. Basal leaves erect, 15–25 × 3–8 mm, entire, blade obovate to orbicular, evidently distinct from petiole, folded; leaf trichomes ca. 0.7 mm diam., tuberculate, 5 or 6 main rays, slightly fused at base, 18 to 22 terminal rays; cauline leaves few, spathulate. Inflorescence racemose; pedicels curved-ascending to slightly sigmoid, 5–8 mm. Sepals pale yellow, 4–5 mm, pubescent; petals yellow, ligulate, 6–7 mm, glabrous; styles glabrous, 4–5 mm; ovary with 4 ovules per locule. Silicles ovoid to ellipsoid, slightly inflated, 2.5–3.5 × 2–3 mm, not compressed at apex, styles longer than silicles; rays of trichomes erect on surface of mature silicles giving fruit shaggy appearance.

Physaria eriocarpa (Sheep Mountain bladderpod) is a compact perennial species with an extremely limited distribution. It is known only from the summit and adjacent ridges of Sheep Mountain in the Pioneer Range of southwestern Montana (Fig. 2). This area was visited by Grady in June 2004 and again by both authors in July 2005. The 2004 collection (*Grady 61*) was made prior to the onset of flowering. *Physaria pulchella* (Rollins) O'Kane & Al-Shehbaz and *P. spatulata* were found flowering and in fruit at lower elevations in the Pioneer Range at the same time. The 2005 visit occurred over a month later in the growing season, and many plants at the type locale were found

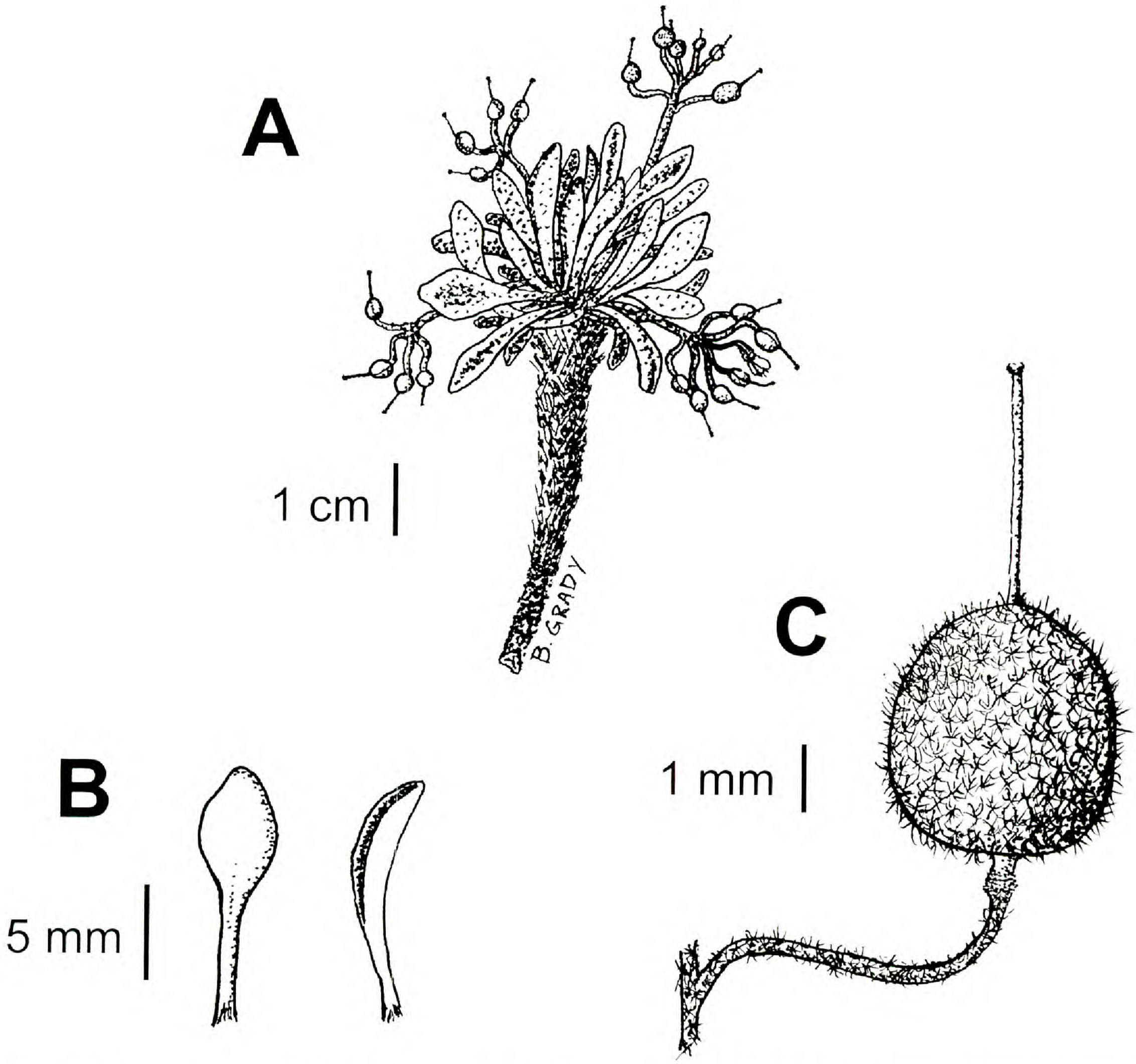

Figure 3. *Physaria eriocarpa* Grady & O'Kane. —A. Plant (pressed). —B. Basal leaf. —C. Silicle and fruiting pedicel. Drawn from the holotype, *O'Kane & Grady 7927* (GH).

with both flowers and fruit (*O'Kane & Grady 7927*, holotype; *O'Kane & Grady 7930*). With the exception of the collections made by the authors, *P. eriocarpa* has been collected on only one other occasion (*C. L. Hitchcock & C. V. Muhlick 12950*) but was identified as *Lesquerella condensata* A. Nelson (= *Physaria nelsonii*) due to similarities in morphology. The recent phylogenetic analysis, based on molecular and morphological data, supports a close relationship between the two taxa (Grady, 2005), but *P. eriocarpa* and *P. nelsonii* are clearly distinct species. Both species are densely caespitose, and the plants appear silvery due to a thick covering of stellate trichomes. The silicles of *P. eriocarpa* and *P. nelsonii* appear shaggy because the rays of the trichomes are long, up to 0.5 mm, and erect; also the styles are noticeably longer than the mature silicles in both species. The two species can be distinguished by basal leaf shape, silicle shape, and stem length. *Physaria eriocarpa* has obovate to orbicular basal leaf blades that are distinct from the petioles and are also strongly folded (15–25 mm). The basal leaves of *P. nelsonii* are shorter overall (5–15 mm), oblanceolate in outline, and the blade gradually narrows to the petiole. The mature silicles of *P. eriocarpa* are not apically compressed, while the silicles of *P. nelsonii* show strong apical compression in both planes. Fruiting stems in *P. eriocarpa* are long (3.5–9 cm) and exserted well beyond the basal leaves. All *P. nelsonii* specimens examined, as well as all individuals observed in the field, exhibited fruiting stems that were concealed within the basal leaves. The ranges of these two species do not overlap and are geographically separated by ca. 320 km.

Physaria eriocarpa is easily distinguished from other species of *Physaria* occurring in nearby areas.

Physaria pulchella is a narrow endemic of the Pioneer Mountains and adjacent areas in Montana and Idaho. The silicles of *P. pulchella* are strongly compressed contrary to the septum (Rollins, 1995), while the silicles of *P. eriocarpa* show no plane of compression. *Physaria spatulata*, a broadly distributed species, is also known from the Pioneer Range. Its silicles show strong apical compression and have trichomes that are closely appressed to the surface of mature silicles. *Physaria eriocarpa*, as mentioned before, has silicles that are not apically compressed, and the rays of the trichomes are long, up to 0.5 mm, and erect, giving the silicle a shaggy appearance. *Physaria eriocarpa* can be distinguished from *P. pycnantha* Grady & O'Kane by the shape of the basal leaves and the shape of the silicles. The basal leaves of *P. pycnantha* are nearly linear to spathulate and show no distinction between blade and petiole; the silicles also exhibit apical compression.

Paratypes. U.S.A. **Montana:** Beaverhead Co., Pioneer Mtns., summit of Sheep Mtn., windswept alpine fellfield of limestone cobbles, 23 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7930* (GH, ISTC, MO, RM); Pioneer Mtns., S of Dewey, crest of limy ridge betw. Sheep & Black Lion Mtns., off hiking trail, ca. 2 mi. from trailhead, 17 June 2004, *B. R. Grady 61* (ISTC); on high limestone ridge connecting Sheep & Black Lion Mtns., Pioneer Range, 30 July 1945, *C. L. Hitchcock & C. V. Muhlick 12950* (CAS, CS, DS, NY, RM, WS).

3. Physaria pachyphylla O'Kane & Grady, sp. nov. TYPE: U.S.A. Montana: Carbon Co., S foot slopes of Pryor Mtns., W of Penney Peak, just N of Wyoming line on Gyp Springs Rd., barren hills of light pinkish limestone rubble, 1 July 1998, *S. L. O'Kane Jr. 4511 & A. Prather-O'Kane* (holotype, GH; isotypes, BRY, COLO, ISTC, MO, MONTU, NY, RM). Figure 4.

Haec species ad *Physariam spatulatam* (Rydberg) Grady & O'Kane maxime accedit, sed ab ea foliis basalibus incrassatis, pedicellis superne incurvatis atque siliqua globosa ellipsoideave distinguitur.

Perennial, loosely mounded, rosette-like growth form, caudex rarely branched, 4–7 mm thick; stems decumbent to prostrate, 2–5 cm, well exserted beyond basal leaves. Basal leaves oblanceolate to orbicular, entire, 12–20 × 4–7 mm, blade distinct from petiole, somewhat cupped, leaf tip acute, leaves nearly 1 mm thick, appearing pale green due to covering of stellate trichomes; leaf trichomes to 0.5 mm diam., 5 main rays, twice bifurcate, slightly fused near bases of main rays, terminal rays 16 to 20, rays tuberculate, appressed close to leaf surface; cauline leaves spathulate. Inflorescences racemose; pedicels curved-ascending, 5–7 mm. Sepals pale yellow, 3.5–4 mm, pubescent; petals yellow, ligulate, 5–6 mm; styles 1–3 mm; ovary with 4 ovules per locule. Silicles globose to ellipsoid, slightly inflated, showing slight apical constriction, 3–6 × 3–4 mm, styles shorter than mature silicles; silicles pubescent, trichomes closely appressed to silicle surface.

Physaria pachyphylla (thick-leaf bladderpod) was collected and recognized as a novel taxon by O'Kane in July 1998 from the Pryor Mountain desert of Montana (Fig. 2). Further herbarium research showed that Peter Lesica collected specimens of *P. pachyphylla* in 1991; these specimens were identified as *Lesquerella alpina* var. *spatulata* (Rydberg) Payson by Rollins (Lesica, pers. comm.). This area of Montana, just north of the Wyoming border, is dry and contains a variety of edaphic conditions. Populations of *P. pachyphylla* are apparently limited to pinkish or reddish soils derived from limestone or a combination of limestone and diatomaceous earth in a small portion of the Pryor Mountain desert (ca. 60 km^2) from 1300 to 1600 m above sea level. Other plants present in these dry, barren areas are compact, mat-forming perennials. *Stipa* L., *Atriplex* L., *Eriogonum* Michaux, *Phlox* L., *Cryptantha* Lehmann ex Fischer & C. A. Meyer, *Astragalus* L., *Petradoria* Greene, *Arenaria* L., and *Elymus* L. are a few of the associated grass and forb genera, while *Pinus flexilis* E. James, *Juniperus osteosperma* (Torrey) Little, and *Cercocarpus ledifolius* Nuttall are the concomitant woody species.

Other members of *Physaria* are also present in the Pryor Mountains, although not in the same vicinity as *P. pachyphylla*. The recently described *P. lesicii* (Rollins) O'Kane & Al-Shehbaz is also endemic to the Pryor Mountains, but it is found at higher elevations and is not associated with the *P. reediana* species complex (Rollins, 1995). *Physaria lesicii* is much less robust than *P. pachyphylla*, possessing thin caudices and filiform stems and pedicels. The shape of the fruiting pedicels also differentiates these taxa. *Physaria lesicii* has pedicels that are recurved in an arc, while the pedicels of *P. pachyphylla* are curved-ascending. Populations of *P. spatulata* can also be found in the Pryor Mountains, although on different soil types. The pedicels of *P. spatulata* are strongly sigmoid and much longer than the silicles; the basal leaves also are not thickened, as are those of *P. pachyphylla*. *Physaria curvipes*, while not found in the Pryor Mountains, is present in the adjacent Big Horn Mountains. The thickened leaves of *P. pachyphylla* distinguish it from *P. curvipes*.

Paratypes. U.S.A. **Montana:** Carbon Co., Gypsum Creek just N of Wyoming border, barren ridge of limestone & diatomaceous earth, pinkish white soil, 21 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7920* (ISTC, MO); betw. Crooked &

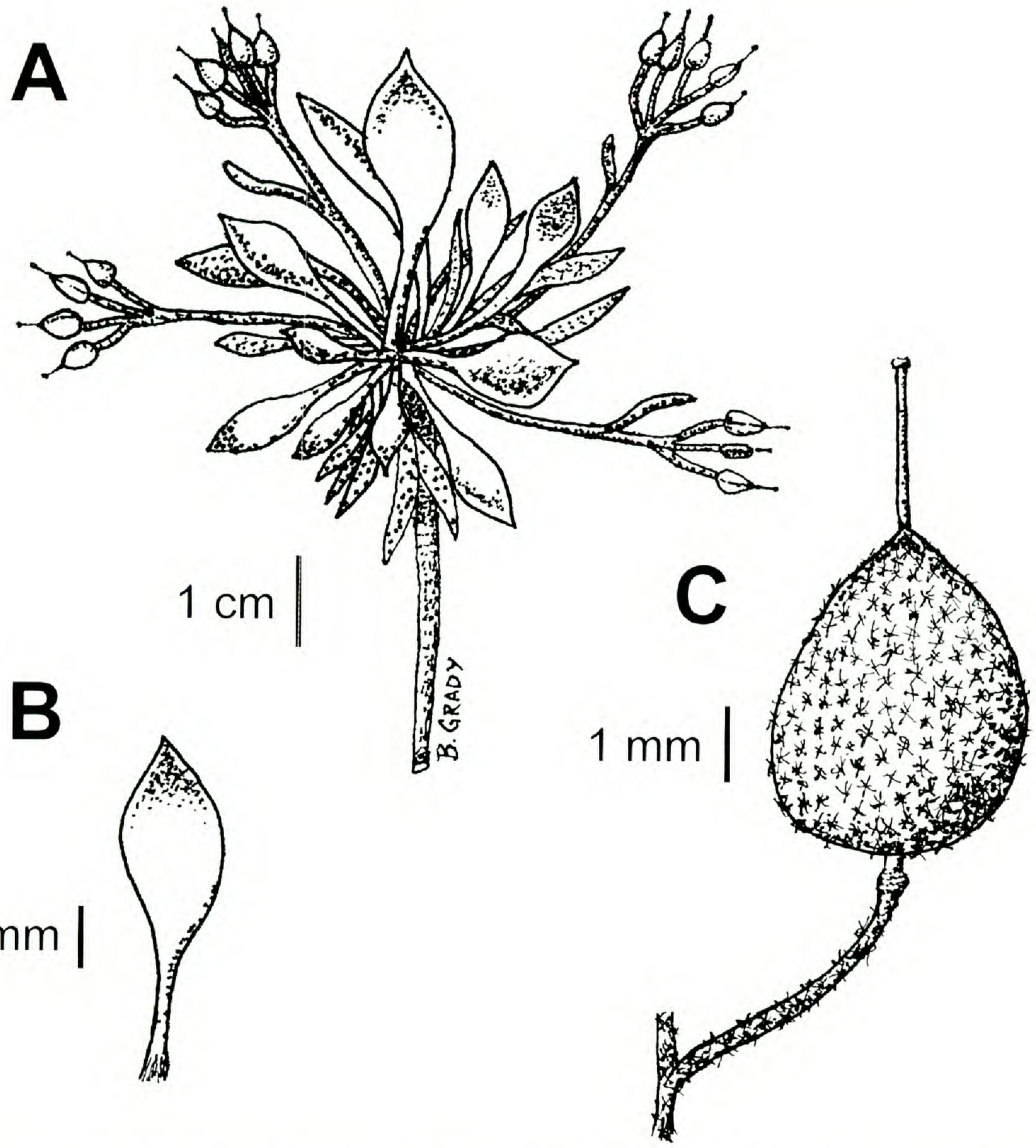

Figure 4. *Physaria pachyphylla* O'Kane & Grady. —A. Plant (pressed). —B. Basal leaf. —C. Silicle and fruiting pedicel. Drawn from the holotype, *O'Kane & O'Kane 4511* (GH).

Gypsum Creeks, SSE of Penney Peak, limy-shale hills of white to reddish chip rock, 21 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7921* (GH, ISTC, MO, RM); betw. Layout & Crooked Creeks in foothills area at end of Sykes Ridge, gravelly red limestone-derived soil, 21 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7925* (GH, ISTC, MO, RM); Pryor Mtn. Desert, on a ridge above Gypsum Creek, ca. 3 mi. NW of Gyp Springs, 12 June 1991, *P. Lesica 5411* (MONTU); Pryor Mtn. Desert, common on rocky limestone ridge tops on the E side of Crooked Creek, ca. 10 mi. N of Lovell, WY, 18 June 1991, *P. Lesica 2608* (MONTU); Pryor Mtn. Desert, uncommon in a sandstone outcrop where road crosses small valley ca. 1 mi. N of Gyp Springs, 10 June 1991, *P. Lesica 5368* (GH, MONTU); Big Horn Canyon NRA near old park entrance, aspect SE 20% slope, 8 July 1998, *B. Heidel 1731* (MONTU).

4. **Physaria pycnantha** Grady & O'Kane, sp. nov. TYPE: U.S.A. Idaho: Custer Co., on gravelly outwash mesa of limestone origin 2 mi. W of Dickey, 6400 ft., 13 June 1945, *C. L. Hitchcock & C. V. Muhlick 8903* (holotype, RM; isotypes, CAS, DS, GH, MO, MONT, NY, UTC, WS). Figure 5.

Haec species ad *Physariam nelsonii* (A. Nelson) O'Kane & Al-Shebaz maxime accedit, sed ab ea foliis basalibus linearispathulatis, stylis brevioribus, trichomatum radiis brevioribus sed multioribus atque caule ex foliis basalibus bene exserto distinguitur.

Densely caespitose perennial forming hemispheric mounds 2.5–8 cm diam.; multicipital, caudices 3–5 mm thick; stems 2.5–7 cm, often exserted beyond basal leaves. Basal leaves entire, linear-spathulate, 15–40 × 1.5–3 mm, blade narrows gradually to petiole, appear silvery due to dense covering of stellate trichomes; leaf trichomes to 0.5 mm diam., trichome surface covered in tubercles, with 5 main rays, twice bifurcate with 16 to 24 terminal rays; cauline leaves few, spathulate. Inflorescences terminal, with 4 to 10 flowers crowded in terminal third; pedicels loosely sigmoid, 6–10 mm. Sepals pale yellow, 3–4 mm, sparsely covered with stellate trichomes; petals yellow, some with slight tinge of orange near base of petal blade, ligulate, 4–6 mm; 2

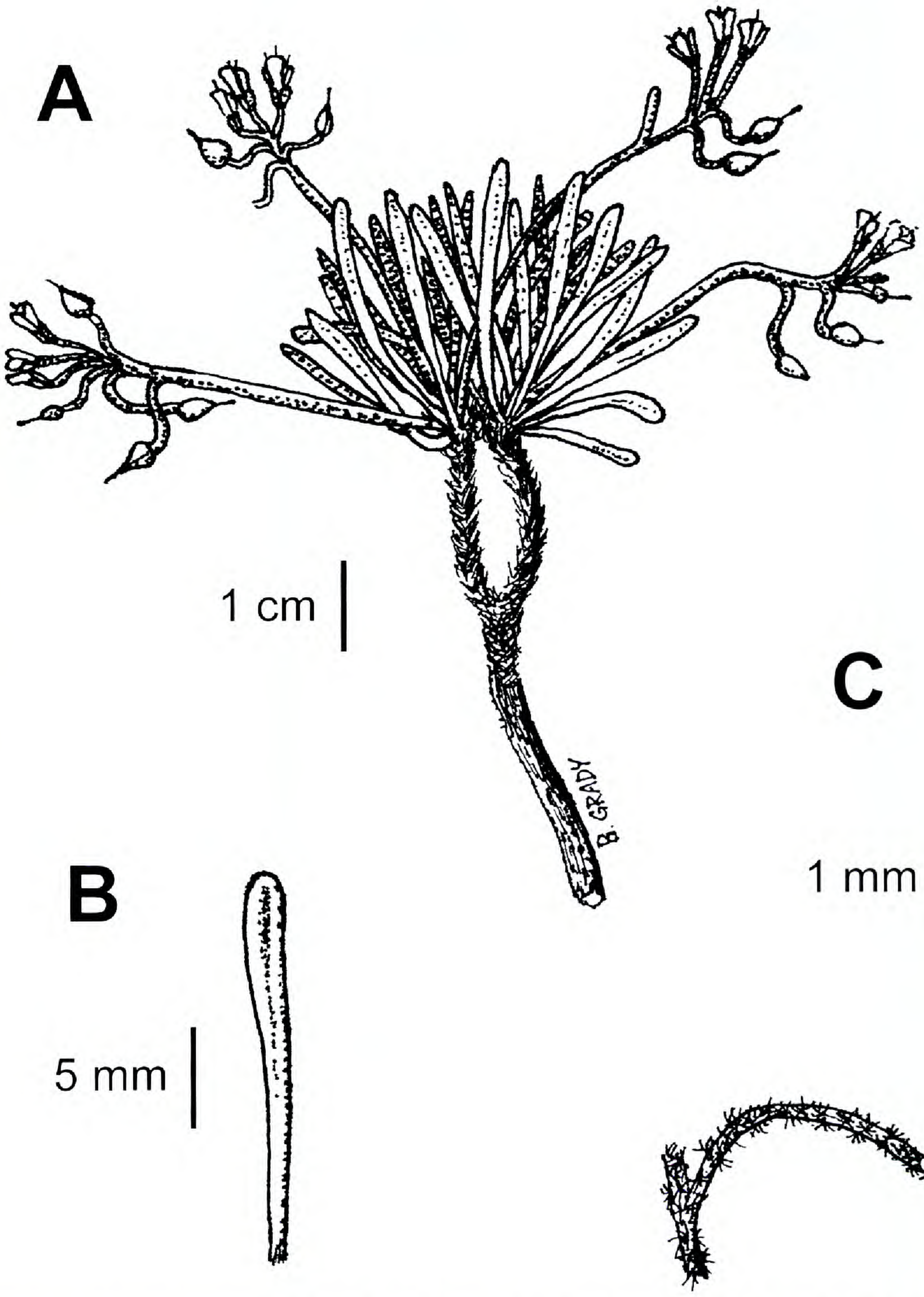

Figure 5. *Physaria pycnantha* Grady & O'Kane. —A. Plant (pressed). —B. Basal leaf. —C. Silicle and fruiting pedicel. Drawn from *Grady 53* (ISTC).

or 4 ovules per locule; styles 2.5–3 mm, glabrous. Silicles ellipsoid, slightly inflated and somewhat flattened parallel to the septum, 3.5–5 × 2–3.5 mm, apex of silicles acute, mature silicles appearing slightly shaggy due to erect rays of trichomes covering silicles; styles shorter than silicles.

Physaria pycnantha (mountain-view bladderpod) occurs over a fairly broad area in east-central Idaho and southwest Montana (Fig. 2); however, populations are not evenly distributed over this range. The elevational range for *P. pycnantha* varies from 1690 to 2290 m. This mound-forming species is most often found on dry, windswept knolls, composed of gravelly substrate originating from limestone parent material. While never a dominant member of a community, *P. pycnantha* can be abundant. It inhabits sparsely vegetated areas associated with various shrub species. *Physaria pycnantha* can be found growing with other cushion-forming plants including: *Erigeron compositus* Pursh, *Phlox albomarginata* M. E. Jones, and *Phlox muscoides* Nuttall.

Specimens of *Physaria pycnantha* were formerly identified as *P. nelsonii* (= *Lesquerella condensata*). These two species have many morphological similarities but appear not to be directly related based on the molecular phylogeny (Grady, 2005). A compact growth form, trichomes with erect rays, and loosely sigmoid fruiting pedicels are some of the traits shared by *P. pycnantha* and *P. nelsonii*. *Physaria pycnantha*

can be distinguished from *P. nelsonii* by having styles that are shorter than the mature silicles and fruiting stems that are often exserted beyond basal leaves. The styles of *P. nelsonii* are roughly equal to or exceed the length of the mature silicles, and the fruiting stems are always buried within the basal leaves. Slight differences can also be seen in the trichome morphology of the two species. The rays of *P. pycnantha* are shorter, more numerous, and fused near the bases, while the rays of *P. nelsonii* are longer, fewer in number, and not fused. *Physaria pycnantha* and *P. nelsonii* are never found in adjacent habitats, being geographically separated by more than 240 km in Idaho/Montana and Wyoming, respectively.

The northern extreme of the range of *Physaria pycnantha* is shared with that of the widespread *P. spatulata*. The features that best distinguish these two species are basal leaf shape and pubescence of the silicles. The basal leaves of *P. pycnantha* range from nearly linear to spathulate, while *P. spatulata* has basal leaves with blades that are wider and distinct from the petioles. As stated previously, the silicles of *P. pycnantha* appear shaggy due to the erect rays of the trichomes. The trichome rays are closely appressed to the surface of the silicles in *P. spatulata*. The growth form of *P. spatulata* is also more lax than the compact habit of *P. pycnantha*. The silicles of *P. reediana* have trichomes with rays closely appressed to the surface, as well as styles that are obviously longer than the silicles. The appressed trichome rays of *P. parvula* are also the discriminating trait when compared to *P. pycnantha*.

Paratypes. U.S.A. **Idaho:** Butte Co., near Hawley Mtns., side road off Pass Creek Rd., 17 mi. NNE of Hwy. 93, rocky knoll over Pass Creek, limestone gravel, 15 July 2004, *B. R. Grady 53* (ISTC); Lemhi Co., just W of Hwy. 28 near milepost 55, near Mammoth Canyon Rd., sagebrush flats and hills, clayey soil with limestone pavement, 30 June 1998, *S. L. O'Kane Jr. & A. Prather-O'Kane 4504 & 4505* (ISTC); Custer Co., Malm Gulch, ca. 12 mi. S of Challis on Hwy. 75, then 1.1 mi. E on Malm Gulch Rd., crest of sandy hill, 15 June 2004, *B. R. Grady 54* (GH, ISTC, MO, RM). **Montana:** Beaverhead Co., S of Clark Canyon Reservoir on Old Armstead Rd., 3.4 mi. NW of exit 37, Interstate 15, gently sloping hillside with scattered limestone outcrops, 16 June 2004, *B. R. Grady 58* (GH, ISTC, MO, RM); 4 mi. NW of Argenta, S end of Pioneer Mtns., cobbley roadcut of rounded alluvium with some limy rocks, 25 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7947* (ISTC, MO); S toe-slope of Limestone Mtn., NNW of Dillon, limestone gravel and cobbles, 25 July 2005, *S. L. O'Kane Jr. & B. R. Grady 7949* (GH, ISTC, MO, MONT, NY, RM); S end of Pioneer Mtns., 4 mi. NW of Argenta, 15.6 air mi. WNW of Dillon, loose limy roadcut with granite and limestone gravel, 16 June 2004, *B. R. Grady 59* (GH, ISTC, MO); Lewis & Clark Co., N of Helena in saddle along gravel road to Hauser Dam, 14 May 1980, *D. J. Ramsden 527* (MONTU).

5. **Physaria spatulata** (Rydberg) Grady & O'Kane, comb. nov. Basionym: *Lesquerella spatulata* Rydberg, Contrib. U.S. Natl. Herb. 3: 486. 1896. *Lesquerella alpina* var. *spatulata* (Rydberg) Payson, Ann. Missouri Bot. Gard. 8: 210. 1921, as "*spathulata*." *Physaria reediana* subsp. *spatulata* (Rydberg) O'Kane & Al-Shehbaz, Novon 12: 327. 2002. TYPE: U.S.A. South Dakota: Lawrence Co., Black Hills, Deadwood, 5000–6000 ft., 5 July 1892, *P. A. Rydberg 534* (holotype, US; isotype, NY). Figure 6.

Perennial, loosely spreading from small (2–6 mm diam.), unbranched caudex; stems erect to decumbent, well exserted beyond basal leaves, 3–12 cm. Basal leaves erect to prostrate, inner basal leaves spathulate to oblanceolate, outer basal leaves oblanceolate to orbicular, 15–40 × 3–8 mm, blade evidently distinct from petiole, rarely folded; cauline leaves few, spathulate, evidently different than basal leaves; leaves sparsely covered by stellate trichomes; trichomes with 4 or 5 main rays, not fused, 15 to 20 terminal rays, closely appressed to leaf surface, to 0.4 mm diam. Inflorescences racemose with 6 to 20 flowers clustered on upper half of stem; pedicels strongly sigmoid, 10–20 mm, 2 × longer than silicles. Sepals pale yellow, 3.5–5 mm, pubescent; petals yellow, ligulate, 6–9 mm; styles 2.5–6 mm, usually ± equal to mature silicle length; 2 or 4 ovules per locule. Silicles various, lanceolate to globose, slightly inflated, (2.5–)3–6 × 2–3.5 mm, usually strongly narrowed at apex, silicle trichomes sparse, closely appressed to surface.

Physaria spatulata (spatula-leaf bladderpod) was first described by Rydberg in 1896 from the Black Hills of South Dakota. At various times it was recognized as an intra-specific taxon of *P. reediana* (= *Lesquerella alpina*) or as a variant form of that species undeserving of taxonomic rank (Payson, 1921 [1922]; Rollins & Shaw, 1973). We believe *P. spatulata* to be a distinct taxon worthy of specific rank. Besides obvious morphological differences, *P. spatulata* and *P. reediana* are not directly related based on recent molecular studies (Grady, 2005). This unexpected result is counter to the previous taxonomic treatments of the two species (Payson, 1921 [1922]; Rollins & Shaw, 1973; Rollins, 1993).

Physaria spatulata has a broad geographic distribution and grows at a variety of elevations. It is found in the western counties of Nebraska, South Dakota, and North Dakota, extending west through the northern half of Wyoming, throughout most of Montana, and north to the southern extremes of Saskatchewan and Alberta (Fig. 2). While *P. spatu-*

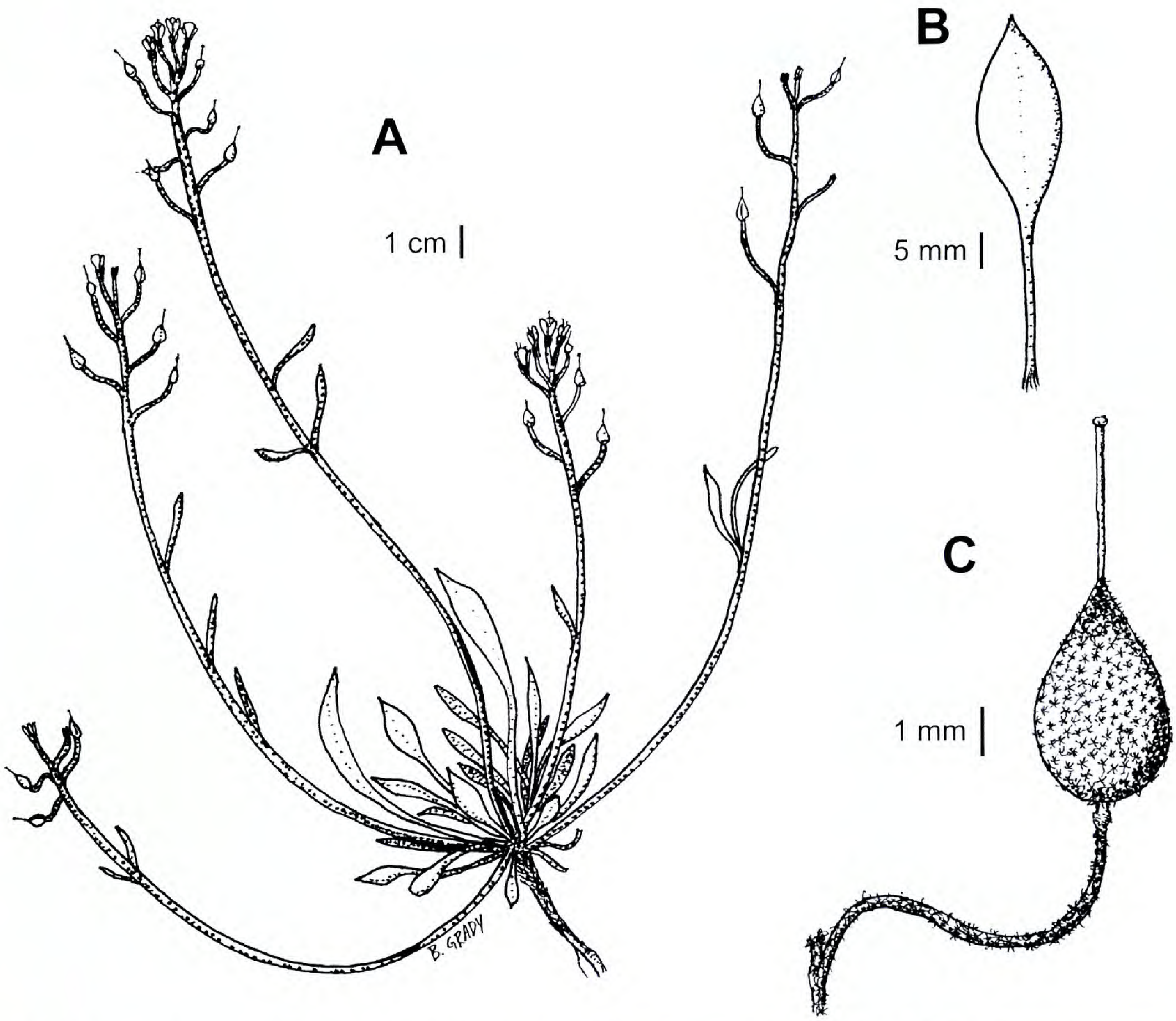

Figure 6. *Physaria spatulata* (Rydberg) Grady & O'Kane. —A. Plant (pressed). —B. Basal leaf. —C. Silicle and fruiting pedicel. Drawn from *Grady 71* (ISTC).

lata is most commonly found in grasslands at elevations from 900 to 1525 m, some populations are present in sub-alpine communities of northern Wyoming and southern Montana up to 2900 m in elevation. High levels of intraspecific variation seem to correspond to these wide geographic and altitudinal ranges. In general *P. spatulata* is a loosely spreading plant, although some exceptions are notable. When found at elevations above 2290 m, it has a more caespitose growth form with a thickened caudex, and the fruiting stems exceed the basal leaves in length. The higher-altitude localities are found in mountain ranges such as the Absorka, Beartooth, and Pryor Mountains along the border between Wyoming and Montana. Some specimens here have basal leaves that are narrower than those usually found in other areas. The typical outer basal leaf of *P. spatulata* is broadly spathulate with an acute apex. The blade is clearly distinguished from the petiole. Some specimens of *P. spatulata* have narrowly spathulate basal leaves, lacking wider blades (most notably some populations from central Montana), but still obviously represent this taxon, based on pedicel and silicle morphology. Silicle shape can also vary somewhat in *P. spatulata*, even among populations. Apical compression is usually evident, and compression parallel to the septum is common. The silicles are usually longer than wide. Although not common, some specimens have been observed to have sub-globose fruits, but these clearly represent variations in form within the species.

Physaria spatulata differs in a number of ways from *P. reediana* and their ranges show little overlap. The growth form of *P. reediana* is more compact than that of *P. spatulata*. *Physaria reediana* has lanceolate basal leaves and styles that are longer than the mature silicles (3–5 mm) and are bent or curled near the stigma. *Physaria spatulata* most closely resembles *P. curvipes*, although their fruit morphologies are different (Figs. 1, 6). *Physaria montana* (A. Gray) Greene is found in mountainous areas in the southern portion of the range of *P. spatulata*. The two species are distinct in that *P. montana* has ellipsoid silicles and cauline leaves that are secund. *Physaria ludoviciana* (Nuttall)

O'Kane & Al-Shehbaz has a broad range that overlaps the range of *P. spatulata* in many areas. Recurved pedicels and involute inner basal leaves separate this taxon from *P. spatulata* (Rollins & Shaw, 1973). Another species that could be confused with *P. spatulata* is *P. lesicii*, which is only known from the Pryor Mountains of southern Montana. The fruiting pedicels of *P. lesicii* are recurved, and the silicles are globose (Rollins, 1995).

Representative specimens examined. CANADA. **Alberta:** bluffs of N fork of Milk River, 3 mi. E of Whiskey Gap, *R. C. Rollins 57212* (B, BM, CAS, GH). **Saskatchewan:** vicinity of Killdeer, 6 mi. N, NE 1/4 6-3-III W 3rd, dry slope of roadcut, soil buff, calcareous silt of Ravenscarg, *J. H. Hudson 2341* (COLO, DAO, ISTC). U.S.A. **Montana:** Carbon Co., near S end of Sykes Ridge, E Pryor Mtn., windswept fellfield, *S. L. O'Kane Jr. & B. R. Grady 7924* (ISTC, MO); Beaverhead Co., S of Dewey, 1 mi. S on road to Quartz Hill Gulch, roadside on steep hill of limestone gravel, *B. R. Grady 60* (GH, ISTC, MO, NY); Choteau Co., White Cliffs area, "Steamboat Rock Landing," in sand and mudstone cliffs, *K. H. Lackschewitz 11660* (GH, MONTU). **Nebraska:** Sioux Co., rocky grassland W of Harrison, *W. Kiener 20482* (NEB). **North Dakota:** Billings Co., eroded prairie pasture hillside, 1/2 mi. S, 6 mi. W of Fryburg, dry rocky gravel clay soil, *S. Stephens & R. Brooks 40276* (WIS). **South Dakota:** Custer Co., limestone ridge of Black Hills, 27 mi. W of Custer, July 1950, *H. D. Ripley & R. C. Barneby s.n.* (GH). **Wyoming:** Campbell Co., 9.1 mi. N of Gillette along Hwy. 59, just N of railroad overpass, loose red gravel at base of rocky outcrop, *B. R. Grady 71* (GH, ISTC, MO, RM).

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Transfer of the Western North American Species *Gilia splendens* to *Saltugilia* (Polemoniaceae), and the Taxonomic Affinities of *Gilia scopulorum*, *Gilia stellata*, and *Gilia yorkii*

Leigh A. Johnson

Department of Integrative Biology and the S. L. Welsh Herbarium, 401 WIDB, Brigham Young University, Provo, Utah 84602, U.S.A. leigh_johnson@byu.edu

Abstract. Two new combinations, *Saltugilia splendens* (Douglas ex H. Mason & A. D. Grant) L. A. Johnson and *S. splendens* subsp. *grantii* (Brand) L. A. Johnson, are proposed for taxa transferred from *Gilia* Ruiz & Pavón on the basis of phylogenetic relationship. The affinities of *G. scopulorum* M. E. Jones, *G. stellata* A. Heller, and *G. yorkii* Shevock & A. G. Day, three species that have been allied with *Saltugilia* V. E. Grant & A. D. Grant when treated as a section of *Gilia*, are reevaluated.

Key words: Classification, *Gilia*, Polemoniaceae, *Saltugilia*, taxonomy.

In elevating *Gilia* Ruiz & Pavón sect. *Saltugilia* V. E. Grant & A. D. Grant to genus rank (Porter & Johnson, 2000), a nomenclatural error was introduced that resulted in the unintentional exclusion of taxa intended to be circumscribed within *Saltugilia* (V. E. Grant & A. D. Grant) L. A. Johnson, as well as a concomitant bibliographic error that merits correction. Background regarding the nomenclatural problem can be found in Grant and Wendt (2003, 2004). In essence, recognizing the illegitimacy of the name *G. splendens* Douglas ex H. Mason & A. D. Grant, Johnson (in Porter & Johnson, 2000) accepted the neotypification of *G. grinnellii* Brand by Grant and Grant (1954), thereby equating *G. grinnellii* with the taxon commonly known as *G. splendens* (Grant & Grant, 1954; Grant & Wendt, 2003). Recognizing the neotypification of *G. grinnellii* by Grant and Grant (1954) was contrary to the code, Grant and Wendt (2003) proposed rejection of this name in order to eliminate confusion and preserve the use of *G. cana* (M. E. Jones) A. Heller, the taxon to which the name *G. grinnellii* correctly applies. This rejection was approved by the General Committee (Barrie, 2006), making *S. grinnellii* (Brand) L. A. Johnson a rejected name also. Grant and Wendt (2004) further proposed to conserve the name *G. splendens* Douglas ex H. Mason & A. D. Grant, and this proposal was likewise approved by the General Committee (Barrie, 2006). Consequently, the transfer of *G. splendens* to the genus *Saltugilia* remains necessary. Furthermore, although *G. splendens*, indicated as type for *Saltugilia* when originally proposed by Grant and Grant (1954) as a section of *Gilia*, was recognized as unavailable for this use by Porter and Johnson (2000), the above committee actions now make *G. splendens* available for use as type for both *Gilia* sect. *Saltugilia* and the genus *Saltugilia*. The bibliographic citation for *Saltugilia* is corrected below (relative to Porter & Johnson, 2000) for accuracy in future reference.

The circumscription of *Saltugilia* as a genus has also changed since Porter and Johnson (2000), with the addition of a newly described species. The broader circumscription of *Saltugilia*, however, when treated as a section of *Gilia* (i.e., Grant, 2004), continues to include species that have no demonstrated affinity with the core elements of this group, although they do show affinity with core *Gilia* in both morphological and molecular characters. Evidence bearing on the classification of these species is reexamined.

Saltugilia (V. E. Grant & A. D. Grant) L. A. Johnson, Aliso 19: 69. 2000, em. *Gilia* sect. *Saltugilia* V. E. Grant & A. D. Grant, Aliso 3: 84. 1954, p.p. TYPE: *Gilia splendens* Douglas ex H. Mason & A. D. Grant.

Saltugilia splendens (Douglas ex H. Mason & A. D. Grant) L. A. Johnson, comb. nov. Basionym: *Gilia splendens* Douglas ex H. Mason & A. D. Grant, nom. cons., Madroño 9: 212. 1948. TYPE: U.S.A. California: Monterey Co., Santa Lucia Mtns., Tassajara Hot Springs, 1530 ft., 26 Apr. 1933, *R. S. Ferris 8317* (holotype, designated by Grant & Wendt, 2004: 842, UC).

Saltugilia splendens (Douglas ex H. Mason & A. D. Grant) L. A. Johnson subsp. **grantii** (Brand) L. A. Johnson, comb. nov. Basionym: *Gilia collina* Eastwood var. *grantii* Brand, Pflanzenr. IV, 250: 101. 1907. TYPE: U.S.A. California: Los Angeles Co., Mt. Wilson, 2000 m, June 1902, *G. B. Grant 503* (holotype, CAS).

Circumscription of *Saltugilia*

Saltugilia includes four closely related species: *S. australis* (H. Mason & A. D. Grant) L. A. Johnson, *S. caruifolia* (Abrams) L. A. Johnson, *S. latimeri* T. L. Weese & L. A. Johnson, and *S. splendens*. These differ morphologically from one another primarily in floral characteristics (Porter & Johnson, 2000; Weese & Johnson, 2001). Grant (2004: 538) treats *Saltugilia* as a section of *Gilia*, recognizing within this section the four species above as one group, and a second group of three additional species (*G. scopulorum* M. E. Jones, *G. stellata* A. Heller, and *G. yorkii* Shevock & A. G. Day) with a note that "...there is a problem concerning the closeness of the relationships between the two groups and within the second group itself...the species of the second group are retained in the sect. *Saltugilia* until we know better what to do with them."

Publications that address the composition of *Saltugilia* at any rank, in all or in part, include Grant and Grant (1954, 1956), Grant (1959), Day (1993a, b), Johnson et al. (1996), Porter (1996), Shevock and Day (1998), Grant (1998), Porter and Johnson (2000), Weese and Johnson (2001), Grant (2004), and Weese and Johnson (2005). A close examination of these publications reveals that most lack discriminating detail in the presentation of morphological characters. For example, an affinity between *Gilia scopulorum* and *G. stellata* with core *Saltugilia* was suggested by Grant and Grant (1956) and the transfer of these species into *Saltugilia* made by Grant (1959), but neither publication presents explicit evidence for such a relationship beyond a general list of characters for the taxon *Saltugilia*. Importantly, section *Saltugilia* in both publications included species now excluded entirely from *Gilia* by both Porter and Johnson (2000) and Grant (2004), thus diluting the current significance of the character lists earlier presented as diagnostic. Subsequent circumscriptions of *Gilia* sect. *Saltugilia* by Day (1993b) and Grant (1998) have taken the affinity between *G. scopulorum* and *G. stellata* with core *Saltugilia* as res ipsa loquitur (i.e., the thing speaks for itself). The placement of *G. yorkii* in *Saltugilia* (Shevock & Day, 1998) included explicit comparative data, which are revisited below.

As a framework for discussing the affinities of *Gilia scopulorum*, *G. stellata*, and *G. yorkii*, a phylogenetic hypothesis for these species derived from a combined analysis of the nuclear ITS-1 and ITS-2 regions and the chloroplast *trnD-trnT* and *psbM-trnD* spacers (Shaw et al., 2005) is presented here. In addition to these three species, the sampling incorporated representatives of all genera of Gilieae (Porter & Johnson, 2000), including four species from each of the two sections of *Gilia* and each taxon in the genus *Saltugilia* (Appendix 1). Two species of *Aliciella* Brand, which fall outside of tribe Gilieae (Porter & Johnson, 2000), were used as outgroups. Sequences were obtained following the methods of Johnson and Weese (2000) and have been deposited in GenBank (Appendix 1). Parsimony analyses were conducted using PAUP* (Swofford, 1998). Analyses recovered four most parsimonious trees of 746 steps that differ only in the placement of *Lathrocasis* L. A. Johnson and in the relationship of *S. caruifolia* and *S. splendens* subsp. *splendens* relative to other *Saltugilia* (Fig. 1). With respect to *G. scopulorum*, *G. stellata*, and *G. yorkii* relative to their relationship to core *Saltugilia*, the same pattern of relationships shown in Figure 1 is recovered by analyses of the nuclear and chloroplast data separately. It is clear from these data that the chloroplast and ITS regions of *G. scopulorum*, *G. stellata*, and *G. yorkii* are genealogically close to *Gilia* s. str. and substantially divergent from *Saltugilia*. An analysis of partial sequences from a nuclear *idh* gene shows a similar pattern of affinities, though *G. yorkii* was not included in that analysis (Weese & Johnson, 2005).

The most thorough discussion of the relationship between *Gilia scopulorum*, *G. stellata*, and species now recognized as *Saltugilia* suggests similarity between *G. stellata* and *S. australis* (Mason & Grant, 1948: their *G. splendens* subsp. *australis*) in lower leaf form and flower size and color. However, leaf form in *G. stellata* cannot be distinguished from many members of *Gilia* sect. *Arachnion* A. D. Grant & V. E. Grant (e.g., *G. cana* and *G. leptantha* Parish), and neither flower size nor color is uniquely shared by these two species. Instead, in addition to DNA sequences (Fig. 1), *G. scopulorum* and *G. stellata* are distinguished from *Saltugilia* by rounded, rather than cylindrical capsules enclosed by a calyx that tends to be accrescent, rather than rupturing with age (Mason & Grant, 1948). They differ also in their calyx and pedicel glands: those in *Saltugilia* are short stalked, with a head that is generally wider than the gland is tall, whereas *G. scopulorum* and *G. stellata* have glands that are longer than broad (Porter & Johnson, 2000; Weese & Johnson, 2001). Furthermore, whereas these glands extend the entire length of the pedicel in *Saltugilia*, they are clustered most densely just below the calyx in *G. scopulorum* and in *G. stellata* such that the lower portion of long pedicels is frequently glabrous. Such clustering of pedicel glands is not uncommon in *Gilia* sect. *Arachnion*. Section *Arachnion* are diverse in their bearing and distribution of inflorescence glands, but when glands are present, they are longer than broad. Johnson et al. (2004) demonstrated that seed coat ornamentation parallels the trends above. *Saltugilia* have verrucate seed coats

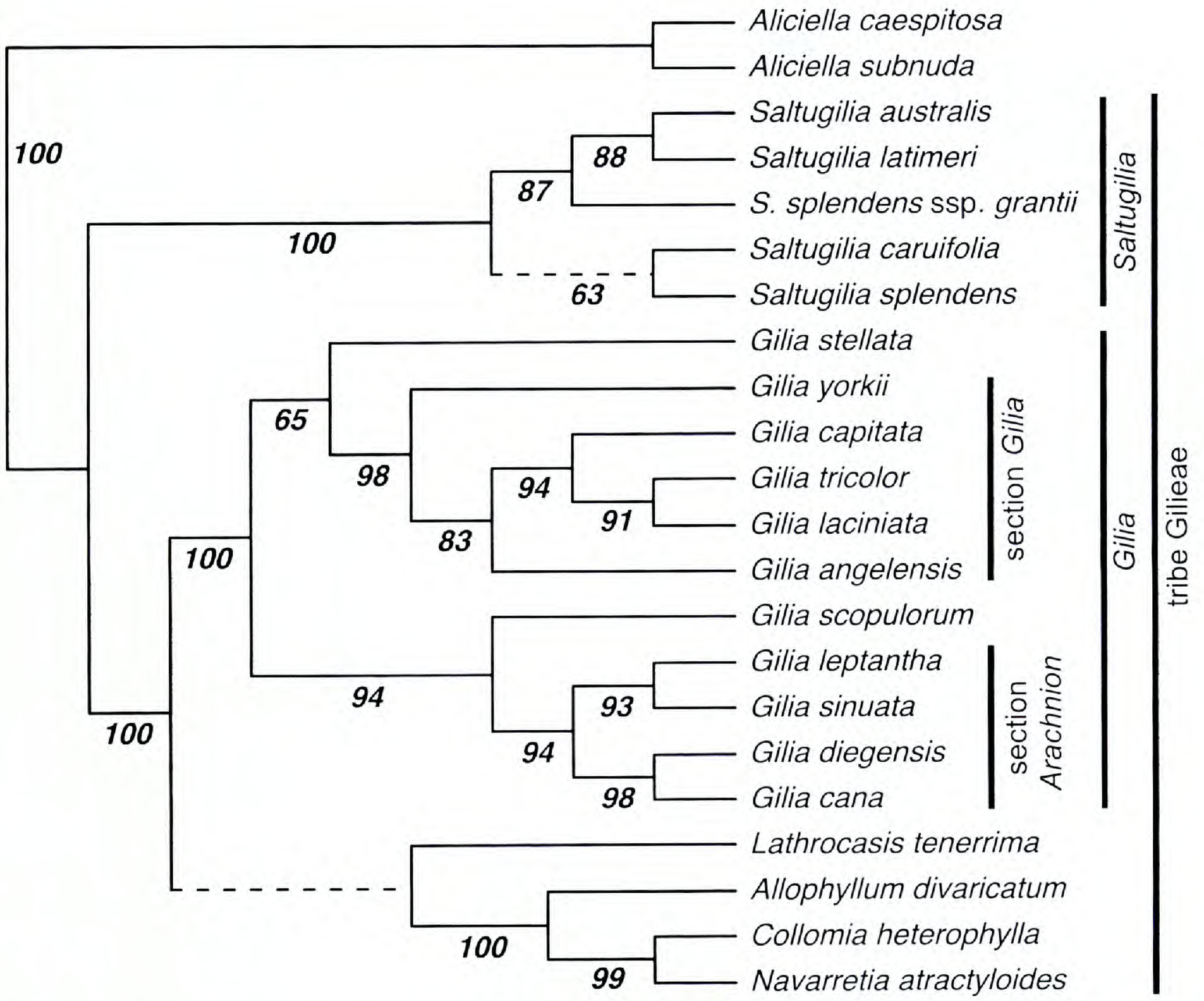

Figure 1. One of four most parsimonious trees recovered from a combined parsimony analysis of nuclear ITS-1 and -2 sequences, and chloroplast *trnD-trnT* and *psbM-trnD* regions (consistency index = 0.87; retention index = 0.92). The topology shown matches the single most parsimonious tree recovered by analyses of these same data with the outgroup excluded. Branches that collapse on the strict consensus of the four most parsimonious trees are indicated with a dashed line. Numbers below branches are bootstrap values from 1000 replications of full heuristic searches.

with caulifloriform verrucae, whereas *G. scopulorum* and *G. stellata*, like other *Gilia* s. str. (as well as *Allophyllum* (Nuttall) A. D. Grant & V. E. Grant, *Navarretia* Ruiz & Pavón, and *Collomia* Nuttall), lack these features of ornamentation.

Relatively recently described, *Gilia yorkii* was placed in section *Saltugilia* based on suggested similarity between it and *G. scopulorum*, not due to similarity with core *Saltugilia* (Shevock & Day, 1998). Like *G. scopulorum*, *G. yorkii* lacks caulifloriform verrucae on its seed coats (Johnson et al., 2004) and is widely divergent in DNA sequence from the genus *Saltugilia* (Fig. 1). However, comparative DNA sequencing indicates a closer relationship between *G. yorkii* and *Gilia* sect. *Gilia* than with *G. scopulorum* (Fig. 1). Significantly, there was no comparative evaluation made between *G. yorkii* and *Gilia* sect. *Gilia* by Shevock and Day (1998), yet I can find no morphological feature that unambiguously excludes *G. yorkii* from this section. For example, although *Gilia* sect. *Gilia* tend to have linear leaf segments, many collections of *G. capitata* Sims have broad leaf lobes like *G. yorkii*. Similarly, whereas *Gilia* sect. *Gilia* tend to have flowers in heads or clusters, *G. tricolor* Bentham, like *G. yorkii*, does not. The pedicel glands of *G. yorkii* are also minute, spheric (with four terminal cells), stalked, and studded along the entire length of the pedicels as in *G. tricolor* and *G. laciniata* Ruiz & Pavón. *Gilia scopulorum*, in contrast, has stout pedicels with large, stalked, flat-topped glands (composed of many terminal cells) clustered along the pedicel predominantly just beneath the calyx.

Available evidence suggests that *Gilia stellata*, *G. scopulorum*, and *G. yorkii* be removed from *Saltugilia* at any rank. Affinities with *Gilia* s. str. are clear. Within *Gilia*, this author suggests *G. scopulorum* and *G. stellata* be placed, at present, without sectional affiliation. *Gilia stellata* and *G. scopulorum* represent early diverging lineages of *Gilia*—lineages that diverged before the synapomorphies currently recognized as circumscribing sections *Arachnion* and *Gilia* evolved in other lineages that subsequently diversified into the specious complexes we recognize by these names today. This treatment allies *G. stellata* and *G.*

scopulorum in a natural group, *Gilia*, in agreement with all present evidence, yet avoids the naming of redundant taxa (i.e., two monotypic sections) or the placement of both species into a single section when there are no demonstrated synapomorphies for these taxa exclusive of other *Gilia*. *Gilia yorkii* should be placed within section *Gilia*, where it shares DNA synapomorphies, features of glandular and eglandular trichome kind and distribution, and where characters that exclude its circumscription are lacking.

Acknowledgments. The author thanks J. Mark Porter for ongoing discussion of relationships in *Gilia* and its segregate genera and Tom Wendt for discussions regarding the nomenclatural issues involved. National Science Foundation grant DEB-0344837 provided support to the author while this manuscript was developed, and NSF grants DEB-9321788 to D. E. Soltis and L. A. J. and DEB-9509121 to J. M. Porter provided funds for extensive field and greenhouse work with these species over the past decade.

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Appendix 1

Vouchers for samples used in DNA sequence analysis (Fig. 1). Taxa are listed alphabetically with collector, herbarium where voucher is deposited, and corresponding GenBank accession numbers given in the order: ITS, *trnD-trnT*, *psbM-trnD*.

Aliciella caespitosa (A. Gray) J. M. Porter, *Anderson & Armstrong 447* (BRY), EF199698, EF199676, EF199654; *Aliciella subnuda* (Torrey ex A. Gray) J. M. Porter, *Clark 05-113* (BRY), EF199699, EF199677, EF199655; *Allophyllum divaricatum* (Nuttall) A. D. Grant & V. E. Grant, *Johnson 04-128* (BRY), EF199700, EF199695, EF199673; *Collomia heterophylla* Hooker, *Johnson 94-076* (BRY), AY997922, EF199696, EF199674; *Gilia angelensis* V. E. Grant, *Johnson 93-029* (BRY), AF208202, EF199686, EF199664; *Gilia cana* (M. E. Jones) A. Heller, *Johnson 93-016* (WS), AF208204, EF199692, EF199670; *Gilia capitata* Sims, *Johnson 92-015* (WS), AF208206, EF199685, EF199663; *Gilia diegensis* (Munz) A. D. Grant & V. E. Grant, *Johnson 93-030* (BRY), EF199706, EF199691, EF199669; *Gilia laciniata* Ruiz & Pavón, *Morrell 403* (RSA), AF208208, EF199688, EF199666; *Gilia leptantha* Parish, *Johnson 93-045* (CAS), EF199705, EF199690, EF199668; *Gilia scopulorum* M. E. Jones, *R. Johnson 304* (BRY), AF208209, EF199689, EF199667; *Gilia sinuata* Douglas ex Bentham, *Johnson 92-004* (WS), EF199707, EF199693, EF199671; *Gilia stellata* A. Heller, *Johnson 93-059* (WS), AF208212, EF199683, EF199661; *Gilia tricolor* Bentham, *Schultz 93-029* (WS), EF199704, EF199687, EF199665; *Gilia yorkii* Shevock & A. G. Day, *Johnson s.n.* (BRY-484805), EF199703, EF199684, EF199662; *Lathrocasis tenerrima* (A. Gray) L. A. Johnson, *Johnson 93-103* (WS), AF208213, EF199694, EF199672; *Navarretia atractyloides* (Bentham) Hooker & Arnott, *Johnson 04-019* (BRY), EF199708, EF199697, EF199675; *Saltugilia australis* (H. Mason & A.

D. Grant) L. A. Johnson, *Johnson 97-004* (BRY), EF199701, EF199678, EF199656; *Saltugilia caruifolia* (Abrams) L. A. Johnson, *Johnson 93-092* (BRY), AY997940, EF199680, EF199658; *Saltugilia latimeri* T. L. Weese & L. A. Johnson, *Johnson 92-021* (BRY), AY997945, EF199679, EF199657; *Saltugilia splendens* (Douglas ex H. Mason & A. D. Grant) L. A. Johnson, *Johnson 94-035* (BRY), EF199702, EF199681, EF199659; *Saltugilia splendens* (Douglas ex H. Mason & A. D. Grant) subsp. *grantii* (Brand) L. A. Johnson, *Johnson 96-008* (BRY), AY997955, EF199682, EF199660.

A New Species of *Centaurea* Sect. *Acrocentron* (Asteraceae) from Turkey

Zafer Kaya
Zonguldak Karaelmas Üniversitesi, Orman Fakültesi, Bartın, Türkiye. zkaya23@hotmail.com

Mecit Vural
Gazi Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bl., 06500, Ankara, Türkiye

Abstract. A new species of *Centaurea* L. (Asteraceae), *Centaurea elazigensis* Kaya & Vural, from section *Acrocentron* (Cassini) DC. is described and illustrated from Elazığ Province, Turkey. It is closely related to *C. carduiformis* DC. A key comparing diagnostic morphological characters of the new species and *C. carduiformis* is provided. The habitat and conservation status of the species are presented, and the geographical distribution of the new species and other related species is described.

Key words: Asteraceae, Cardueae, *Centaurea*, Compositae, IUCN Red List, Turkey.

Centaurea L. is one of the largest genera in Asteraceae. Depending on the classification used, it comprises between 200 and 700 species (Bremer, 1994; Hellwig, 2004; Bancheva & Greilhuber, 2006). Turkey is one of the main centers of diversity for the genus *Centaurea* (Wagenitz, 1986). In the *Flora of Turkey*, 172 plus six imperfectly known species of *Centaurea* were accepted (Wagenitz, 1975). Since then 11 new species have been described from Turkey (Wagenitz, 1975; Davis et al., 1988; Wagenitz et al., 1998; Güner, 2000; Duran & Duman, 2002; Turkoğlu et al., 2003). In addition to these, four new species have been identified by Uzunhisarcıklı et al. (2005), Duran and Hamzaoğlu (2005), and Wagenitz et al. (2006) from Turkey. In this paper, we describe a new species, after which the total number of *Centaurea* species known from Turkey increases to 194. There are 118 endemic taxa of *Centaurea* in Turkey; therefore, approximately 61% of *Centaurea* species known from Turkey are endemic. *Centaurea* species are found on stony calcareous cliffs, vineyards, roadsides, seashores, gypsum fields, open woods, shrubland, waste places, steppe, fallow fields, maquis, sandy beaches, forests, dry meadows, rocky slopes, and on maritime limestone cliffs in Turkey.

According to Wagenitz (1975), *Centaurea* is a taxonomically difficult genus that needs further study. Cytological data, in particular, which are still inadequate for the *Centaurea* species of the Near East, should be considered to resolve taxonomic limits.

The taxonomic complexity of *Centaurea*, especially in the Near East, has stimulated much recent research (Hellwig, 1994; Kaya, 1986, 1987; Kaya et al., 1996; Türkoğlu et al., 2003; Wagenitz, 1983; Wagenitz & Hellwig, 1997; Wagenitz et al., 1998).

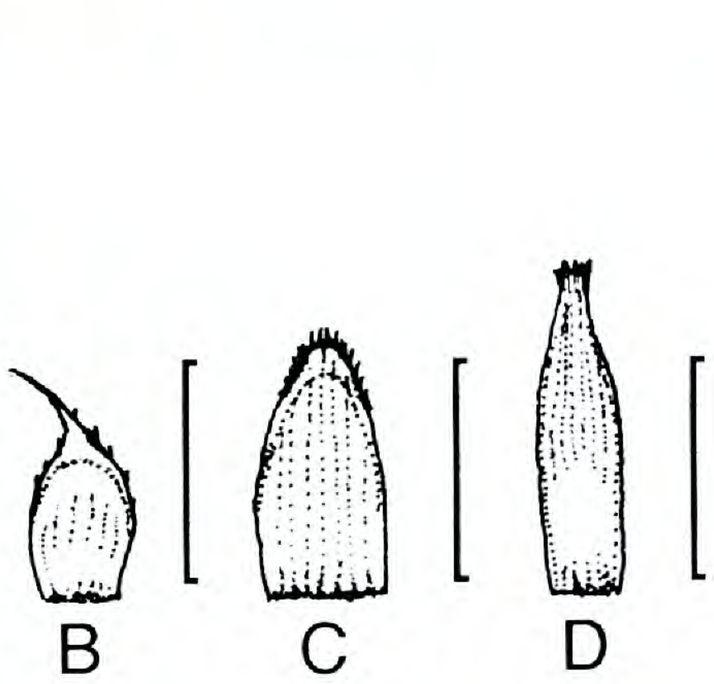
The new species, collected in Baltaşı village, around Elazığ, in eastern Anatolia, Turkey, is deposited in GAZI herbarium. Specimens were compared with allied taxa deposited in GAZI.

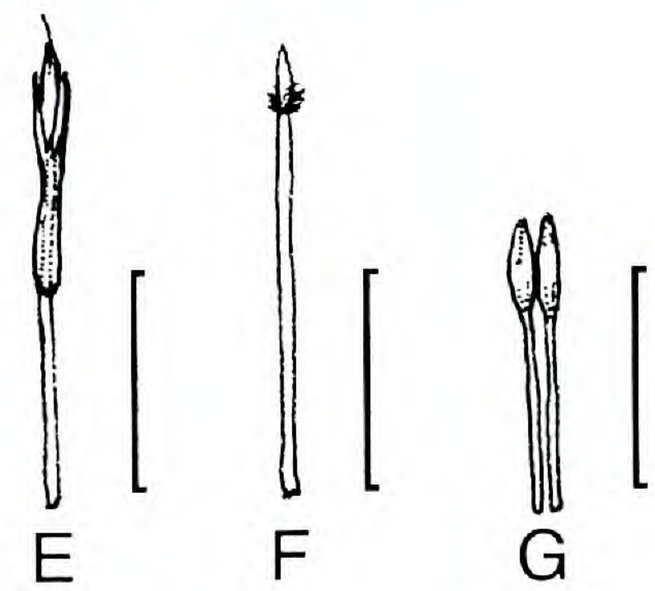
Centaurea elazigensis Kaya & Vural, sp. nov.

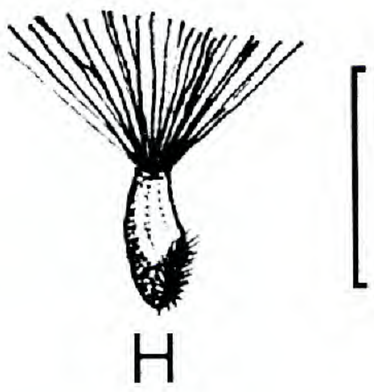
TYPE: Turkey. Elazığ Province (B7): Elazığ–Palu, Baltaşı village, dry and rocky slopes, 1400–1500 m, 20 July 2005, *Z. Kaya 17* (holotype, GAZI). Figures 1, 2.

Haec species *Centaureae carduiformi* DC. affinis, sed appendicula mediana minute denticulata (nec ciliata) in spinulam 1–9 mm longam (nec 10–30 mm) terminanti; acheniis et pappis brevioribus (acheniis 5–5.5 mm (nec 6–10 mm); pappis 5–7 mm (nec 7–10 mm)) differt.

Biennial or perennial with thickened rootstock; stems 1 to 4, erect, striate, 40–120 cm tall, usually branched in upper part with 2 to 5 capitula; lower stem and leaves densely hispid, plant in the upper part scarcely hispid. Basal and lower cauline leaves petiolate, 1- to 2-pinnatisect, 12–18 × 4–8 cm, larger segments 5–6 × 0.4–0.8 cm; median and upper cauline leaves sessile, gradually decreasing in size. Capitula with involucres 15–20 × 16–18 mm, ovoid; appendages small, with a narrow dark brown border, spineless or abruptly narrowed into 1–9 mm spine. Outer and median phyllaries with minutely denticulate appendages at apex terminated with spines, outer phyllaries ovate, 2–5 × 2–5 mm, with spine to 4 mm; median phyllaries ovate to lanceolate, 7–11 × 5–7 mm, with spine to 9 mm; inner phyllaries narrowly lanceolate, 16–18 × 3–5 mm, with hyaline border, denticulate to lacerate appendages at apex without spines. Corolla rose-purple, ca. 23 mm; marginal florets scarcely radiate, with 4–5 mm lobes. Achenes 5–5.5 mm, straw-colored, adpressed white hairy, long-barbellate at hilum.







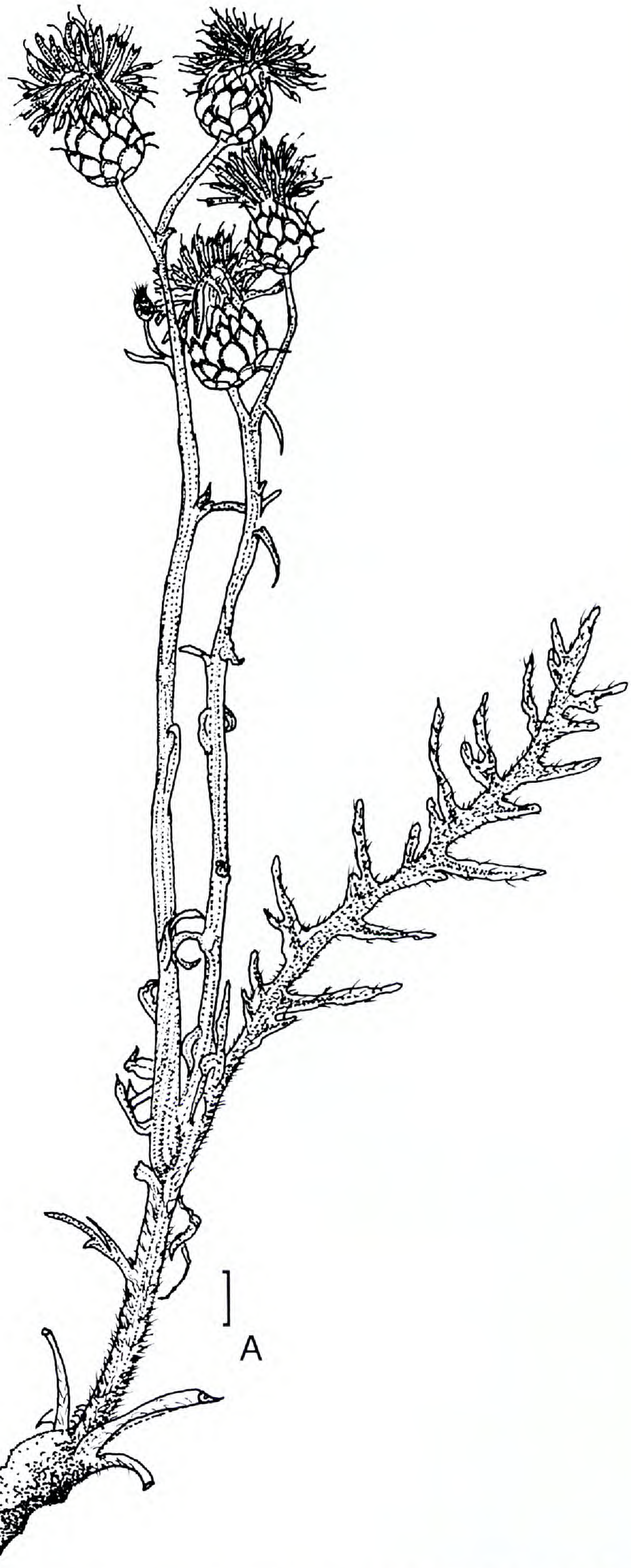


Figure 1. *Centaurea elazigensis* Kaya & Vural. —A. Habit. —B. Outer phyllary. —C. Median phyllary. —D. Inner phyllary. —E. Hermaphrodite tubular floret. —F. Style of hermaphrodite tubular floret. —G. Anther cylinder of hermaphrodite tubular floret. —H. Achene and pappus. Scale bars = 1 cm. Drawn from the holotype, *Kaya 17* (GAZI).

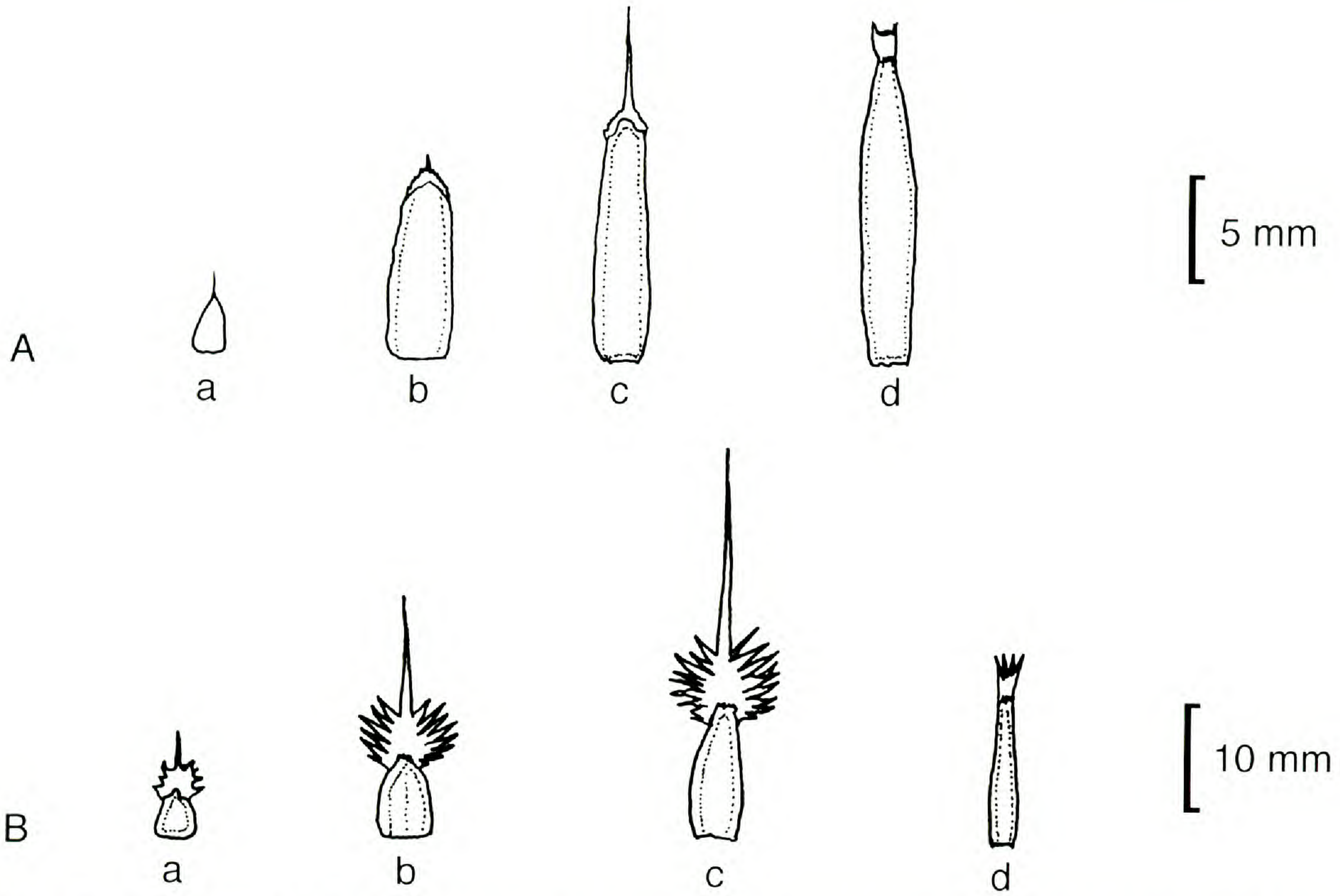


Figure 2. Comparison of phyllaries of *Centaurea elazigensis* (A) and *C. carduiformis* (B). —a. Outer series. —b, c. Median series. —d. Inner series. *C. elazigensis* drawn from the holotype, *Kaya 17* (GAZI); *C. carduiformis* drawn from the holotype, *Vural 5312* (GAZI).

Pappus 5–7 mm, inner row 1.5–2.5 mm, scabrous, straw-colored to brownish.

Phenology. Flowering and fruiting in July.

Habitat and distribution. *Centaurea elazigensis* is endemic to the Irano-Turanian region. It occurs on dry and rocky slopes at 1400–1500 m. *Centaurea elazigensis* was observed on rocky slopes probably derived from the degeneration of disturbed *Quercus* L. woodland with these characteristic plants: *C. antitauri* Hayek, *C. consanguinea* DC., *C. behen* L., *C. stapfiana* (Handel-Mazzetti) Wagenitz, *C. urvillei* DC. subsp. *hayekiana* Wagenitz, *Alyssum samariferum* Boissier & Haussknecht, *Helichrysum plicatum* DC. subsp. *polyphyllum* (Ledebour) P. H. Davis & Kupicha, *Cochlearia sempervivum* Boissier & Balansa, and *Quercus brantii* Lindley.

IUCN Red List category. *Centaurea elazigensis* is endemic to Elazığ Province, eastern Anatolia, in the Irano-Turanian region. The specimens were collected in Elazığ Province (B7), where the species is apparently very rare and local. The species is known only from one population in the type locality and from an area of 100 m^2. The population is not in good condition and numbers approximately 50 to 100 plants. It should be regarded as belonging to Critically Endangered (CR) category (IUCN, 2001), because of its local distribution and rather a small population size.

Relationships. *Centaurea elazigensis* belongs to section *Acrocentron* (Cassini) DC., which includes taxa with few medium-sized capitula, oblong-ovoid to subglobose involucre, and decurrent appendages ending in a spine. The authors conducted a thorough study of the pertinent specimens and the literature (Wagenitz, 1975, 1986; Dostal, 1976; Davis et al., 1988; Wagenitz et al., 1988; Güner et al., 2000; Duran & Duman, 2002; Turkoğlu et al., 2003) and determined that *C. elazigensis* and *C. carduiformis* differ morphologically (Table 1). The diagnostic characters are contrasted in the following key couplet.

Appendages denticulate; spine of median phyllaries up to 9 mm; achenes 5–5.5 mm; pappus 5–7 mm . . . . . *C. elazigensis*

Appendages ciliate; spine of median phyllaries 10–30 mm; achenes 6–10 mm; pappus 7–10 mm . . . . . *C. carduiformis*

Centaurea carduiformis is widespread in Turkey, extending to northwestern Iran and Transcaucasia. It is represented by two subspecies in Turkey. Sub-

Table 1. A comparison of selected characters used to distinguish between *Centaurea elazigensis* and *C. carduiformis*.

Character	*C. elazigensis*	*C. carduiformis*
Stem height (cm)	40–120	40–50
Involucre size (mm)	15–20 × 16–18	17–30 × 15–30
Median spine length (mm)	1–9	10–30
Achenes (mm)	5–5.5	6–7(10)
Pappus (mm)	5–7	7–10
Phyllary appendages	denticulate	ciliate

species *carduiformis* has hispid leaves and is found mainly in central Anatolia; subspecies *orientalis* Wagenitz has leaves not hispid and is found in northeastern Anatolia.

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A New Species of *Luzula* Sect. *Luzula* (Juncaceae) from Costa Rica

Jan Kirschner
Institute of Botany, Academy of Sciences, CZ-25243 Průhonice 1, Czech Republic.
kirschner@ibot.cas.cz

Abstract. A new species of *Luzula* sect. *Luzula* DC., known from higher altitudes of volcanic hills in Costa Rica, is described under the name *Luzula ignivoma* Kirschner. It is most closely related to the Chilean species *L. tristachya* Desvaux. New Central American country records of other species of the Juncaceae are also given: *Juncus marginatus* Rostkovius from Panama, *Juncus hybridus* Brotero, and *J. cooperi* Engelmann from Mexico.

Key words: Central America, Juncaceae, *Juncus*, *Luzula*.

The diversity of the Juncaceae in Central America was recently summarized in several major taxonomic works (Balslev, 1996, 1994; Kirschner et al., 2002a, b, c). However, a more detailed exploration of the extremely rich region and further taxonomic research of complicated groups continue to reveal new taxa and country records. The present paper describes the new species *Luzula ignivoma* Kirschner, identified after herbarium study of Central American material and an expedition to western Panama.

Material and Methods

Herbarium material was studied at (or obtained on loan from) the herbarium collections AAU, F, MO, PR, PRA, and in particular at NY. The material collected by J. Kirschner and L. Kirschnerová in 2004 in Chiriquí Province, Panamá, is deposited at PRA and PMA. For the sake of comparability, all measurements were done according to standard methods (Kirschner et al., 2002a: 19).

Luzula ignivoma Kirschner, sp. nov. TYPE: Costa Rica. Cartago: Volcán Irazú, NE slope below crater, 9°19′N, 83°51′W, 3200 m, 21 Jan. 1983, *G. Davidse 23133, L. D. Gomez, M. Sousa, C. J. Humphries, N. Garwood, R. Hampshire & M. Gibby* (holotype, NY; isotype, MO). Figures 1, 2.

Species e *Luzula* sectione *Luzula* DC. insignis caulibus ad basin incrassatis, saepe subbulbosis, inflorescentia plerumque congesta vel subcongesta, tepalis conspicue acuminato-aristatis et seminibus magnis ellipsoideis breviter carunculatis; *L. tristachyae* Desvaux primo adspectu maxime similis sed rhizomate sat elongato ascendente, caulibus ad basin incrassatis, inflorescentia multiflora interdum ramosa, antheris filamentis paulo longioribus, bracteolis longioribus conspicue ciliatis et stigmatibus brevioribus.

Plants caespitose to loosely caespitose, to 35 cm tall, with short to medium length ascending rhizomes; shoots shortly ascending, usually with swollen, bulbous base; stem ± rigid, erect. Basal leaves numerous, densely arranged, densely ciliate, with papillose margins, ± flat to slightly canaliculate, usually to 8, less often to 12 cm, 3.2–4 mm wide, apex obtuse; cauline leaves 1(to 2), 2–3.5(–7) cm, densely ciliate at the blade base, with densely finely papillose margins. Inflorescence composed of 3 to 6, usually sessile clusters, inflorescence usually more than 30-flowered, congested, usually ca. 1–1.5 × ca. 1 cm, or 1 to 2 clusters pedunculate; clusters of 7 to 12 flowers, inflorescence branches to ca. 3 cm, the longer peduncles ± smooth, straight, 0.5–2 cm, thick (0.4–0.6 mm); overall inflorescence color from paler brown to castaneous; lower inflorescence bract ± erect-patent, 1.2–1.7 cm, not overtopping the inflorescence; bracteoles scarious, narrowly lanceolate, usually long-acuminate, 2–3.5 mm, conspicuously long-ciliate. Tepals narrowly lanceolate to linear-lanceolate, conspicuously long-acuminate, outer ones slightly carinate, 3.2–4 mm, usually ± equaling, seldom distinctly longer or shorter than the inner ones, the inner tepals ca. 0.7–0.8 mm wide, castaneous to dark castaneous, either ± evenly colored or with a gradually paler margin; perianth longer than ripe capsule; stamens 6, anthers 0.7–1(–1.2) mm, slightly longer than 0.6–0.8 mm long filaments; style ca. 0.7–0.8 mm, stigmas 1.5–1.9 mm. Capsule broadly ovoid, 2.3–2.7 mm, apex trigonous-acute, gradually tapering into a short mucro, deep castaneous. Seeds dark brown, narrow, ellipsoid, 1.2–1.3 mm long (excluding appendage), ca. 0.7 mm wide, appendage 0.2(–0.3) mm.

Distribution and ecology. The new species, collected from 3000 to 3300 m in elevation, is confined to high mountain vegetation of volcanic mountains in the province of Cartago, Costa Rica. For the time

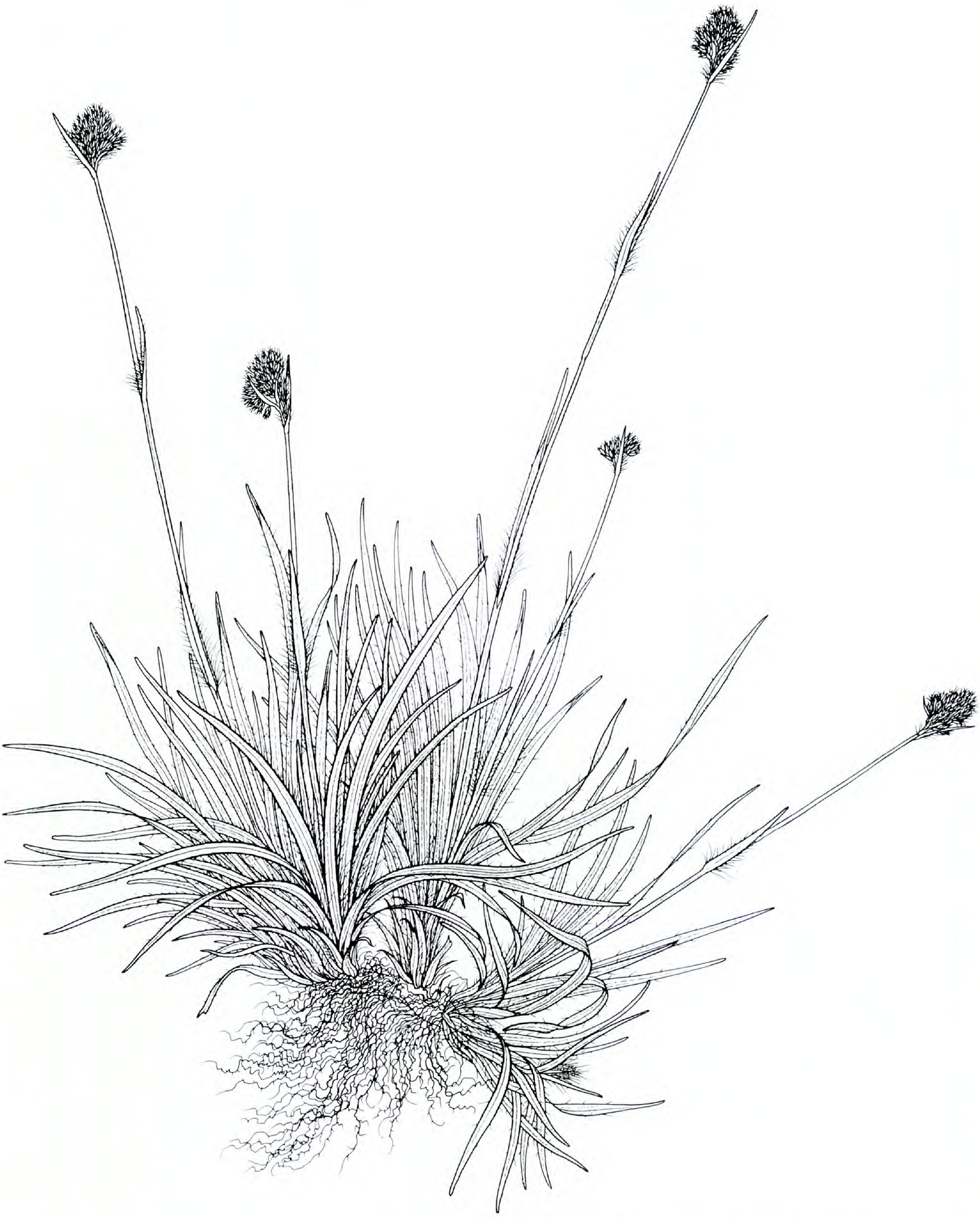

Figure 1. *Luzula ignivoma* Kirschner, general habit. Drawn from the isotype *G. Davidse 23133 et al.* (MO).

being, it is recorded from volcanoes of Turrialba and Irazú.

Relationships. *Luzula ignivoma* is most closely related to the only native Chilean member of *Luzula* sect. *Luzula*, *L. tristachya*. In particular, the two species are almost identical in the seed and capsule characters. The most conspicuous diagnostic features of *L. ignivoma* (see also Table 1 and Figs. 1, 2) are longer, ascending rhizomes; a swollen stem base; a shorter stigma; aristate tepals; longer and narrower, densely long-ciliate bracteoles; and a higher number of flowers in the inflorescence. It should be added that there is no North American member of the section *Luzula* approaching the character combination of the Costa Rican species.

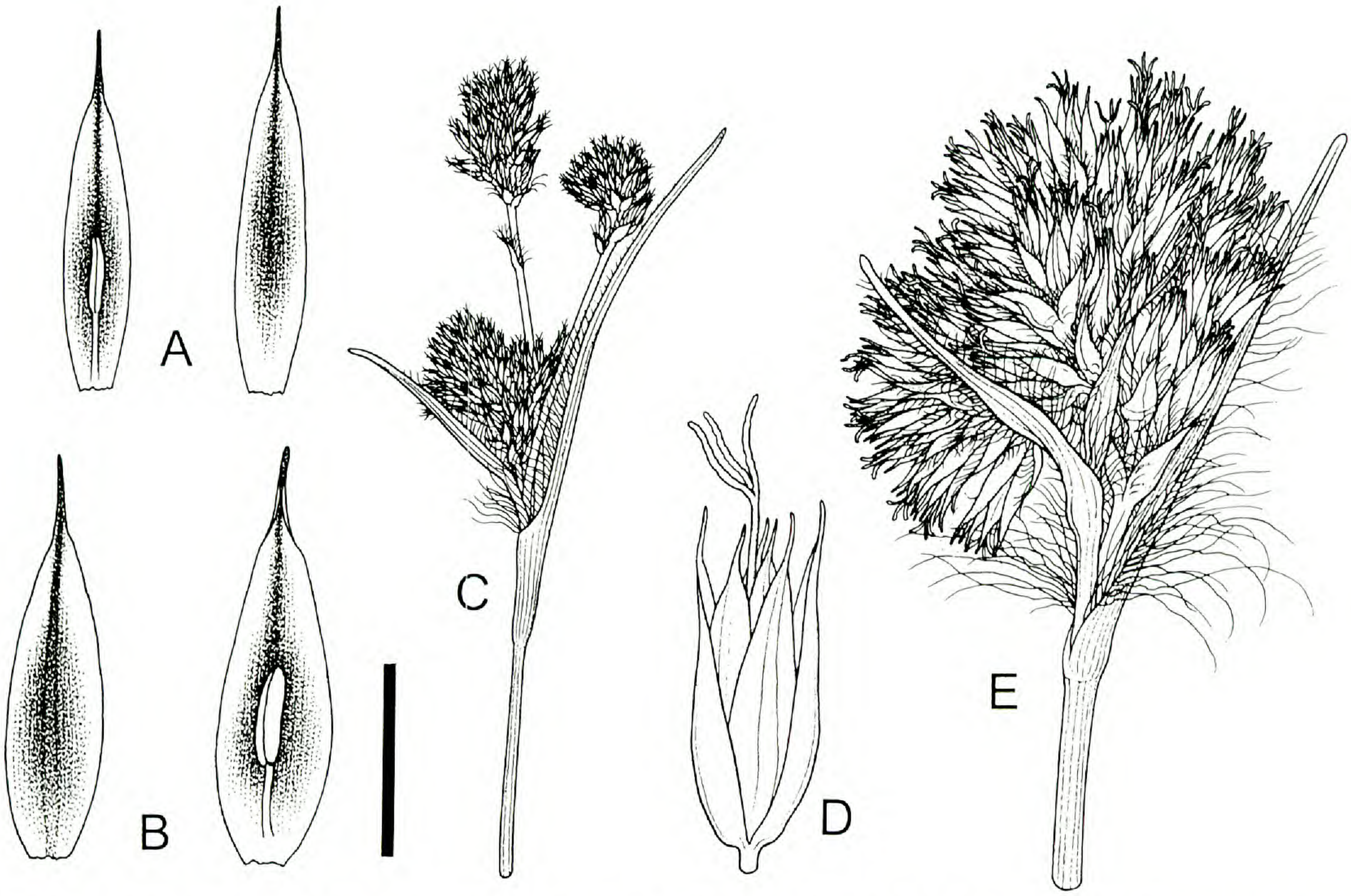

Figure 2. *Luzula ignivoma* Kirschner. —A. Inner tepals. —B. Outer tepals. —C, E. Inflorescence. —D. Flower. Scale bar: A, B, D = 1.5 mm; C = 12 mm; E = 4 mm. A, B, D, E drawn from *G. Davidse et al. 23133* (MO); C from *G. Davidse & R. W. Pohl 1182* (MO).

Most of the specimens cited below were previously studied by H. Balslev (1996) and identified as *Luzula campestris* var. *multiflora*, which was eventually (on the basis of an incomplete AAU specimen) provisionally accepted in the monograph of the family (Kirschner et al., 2002a, under *L. multiflora* subsp. *multiflora*). Although *L. multiflora* (Ehrhart) Lejeune subsp. *multiflora* is an extremely variable taxon, the character combination of *L. ignivoma* is not found among the numerous forms included in the northern subspecies. In particular, the acuminate tepals; usually obovoid, obtuse capsules; densely caespitose growth; and ovate-lanceolate subentire to sparsely ciliate bracteoles 1.5–2.5 mm are different from those of *L. ignivoma*.

Etymology. The specific epithet is from the Latin "ignivomus," defined as fire-vomiting or volcanic.

Paratypes. COSTA RICA. **Cartago:** Volcán Turrialba, upper slopes near rim of crater, *G. Davidse & R. W. Pohl 1182* (F, MO), along creek in partially wooded pasture, *G. Davidse & R. W. Pohl 1183* (AAU, MO, NY), crater rim, *A. S. Weston 6153* (F), S slopes, *A. S. Weston 4961* (F); 12 km N of the jct. at Trinidad en route to Volcán Turrialba, within 0.5 km of crater rim, *F. Almeda 737* (F).

Juncus marginatus, a New Species Report for the Flora of Panama

Juncus marginatus Rostkovius is widespread in many areas of North, Central, and South America. Up to now, it has been recorded from a number of

Table 1. Character comparison between *Luzula tristachya* and *L. ignivoma*.

	L. ignivoma	*L. tristachya*
Rhizome	medium length (usually > 1.5 cm), ascending	short (< 1 cm)
Stem base	swollen, bulbous	not swollen
Flower number in inflorescence	usually > 30	usually < 15–20
Bracteole shape	narrowly lanceolate	ovate
Style/stigma length, mm	0.7–0.8/1.5–1.9	0.4–0.5/2–3
Filament length, mm	0.6–0.8	0.4–0.5
Seed appendage length, mm	0.2(–0.3)	0.1–0.2

localities from Mexico to Costa Rica in Central America, the only country without any records being Panama. During an expedition to the Chiriquí Province, the species was found at several places along the road connecting the town of Chiriquí with the Caribbean side of Panama, mostly in the vicinity of the artificial reservoir of Lago Fortuna. The character of these localities (wet places and ditches along the road) suggests that the species was introduced quite recently.

Juncus marginatus belongs to the section *Graminifolii* G. Engelmann, characterized by flat, grass-like leaves without septa. It is the most widespread species in the section, which is otherwise composed of species with mostly rather small geographical ranges.

Specimens examined. PANAMA. **Chiriquí:** Lago Fortuna region, Quebrada Cristallina, Km 59 of road from Lago Fortuna to Palo Seco, *J. Kirschner & L. Kirschnerová 8a* (PMA, PRA); Quebrada Alemán Trail, near road, *J. Kirschner & L. Kirschnerová 8* (PMA, PRA); Km 45, road betw. Lago Fortuna & town of Chiriquí, *J. Kirschner & L. Kirschnerová 39* (PMA, PRA).

Juncus hybridus New to Mexico

The section *Tenageia* Dumortier of the genus *Juncus* L. comprises annuals that have the highest diversity in the westernmost Mediterranean, particularly in Spain, Portugal, and Morocco. The most common annual species on subsaline soils in that region is *J. hybridus* Brotero. Thus, it is not surprising that the latter species is quite commonly found introduced or naturalized in the territories explored and conquered by Spanish and Portuguese voyagers and conquistadores—Chile, Argentina, California, etc. (Kirschner et al., 2002c). The species was found among the specimens collected in Mexico and deposited in NY. *Juncus hybridus* is related to the group of *J. bufonius* L. It is distinct within this species group in its inflorescence constituting about one third of the plant height and composed of dense 2- to 6-flowered clusters and a perianth usually 5–7.5 mm.

Specimen examined. MEXICO. **San Luis Potosí:** San Luis Potosí, *J. G. Schaffner 211* (NY).

Juncus cooperi, a New Species in Mexico

Juncus sect. *Juncus* comprises mostly coastal obligate halophytes with pungent leaves. One of the most peculiar species of the section, characterized by its stout, creeping rhizome and large seeds (to 1.9 mm), is *J. cooperi* Engelmann, known from inland saline semidesert areas in California and Nevada, U.S.A. (Kirschner et al., 2002b). Some of the known localities are not far from the Mexican border, but it was not until the author studied Mexican material in NY that the species was identified from the northwestern Sonora as a new member of the Mexican flora.

Specimen examined. MEXICO. **Sonora:** NW Sonora, Laguna Prieta, Gran Desierto, *E. Ezcurra* (NY).

Acknowledgments. Thanks are due to the curators of the herbarium collections studied, particularly of AAU, F, MO, NY, PR, and W. I am grateful to M. Correa of PMA for her kind help and support during my Panama stay. *Juncus marginatus* was first spotted by R. K. Brummitt of Kew, and the field identification was assisted by Henrik Balslev of Aarhus, and I am much indebted for their help. The travel and research was supported by the following Czech national grants: GA ČR 206/02/0355, LC 06073, and AV0Z 60050516. Specimens were collected on the basis of Collection and Export Permit no. SEX/P-54-04.

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Three New Species in *Salvia* Subgenus *Calosphace* (Lamiaceae) from Mesoamerica

B. B. Klitgaard

Department of Botany, Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom. b.klitgaard@nhm.ac.uk

Abstract. Three new *Salvia* L. (Lamiaceae) species, *S. colonica* Standley & Williams ex Klitgaard, *S. univerticillata* Ramamoorthy ex Klitgaard, and *S. whitefoordiae* Klitgaard, were revealed during the study of *Salvia* for the *Flora Mesoamericana* in which 69 *Salvia* species in total are recognized for the *Flora* region. The three species belong to *Salvia* subg. *Calosphace* (Bentham) Epling, and they are endemic to Mesoamerica. In this paper the species are described and illustrated, and their morphological affinities and putative relatives are discussed.

Resumen. Durante el estudio de *Salvia* para la *Flora Mesoamericana* se descubrieron tres nuevas especies de *Salvia* L. (Lamiaceae), *S. colonica* Standley & Williams ex Klitgaard, *S. univerticillata* Ramamoorthy ex Klitgaard y *S. whitefoordiae* Klitgaard; en total se reconocen 69 especies de *Salvia* para la región de la *Flora*. Las tres especies pertenecen a *Salvia* subgénero *Calosphace* (Bentham) Epling y son endémicas de Mesoamérica. En este artículo se describen las tres especies como nuevas para la ciencia, se ilustran todas las especies y se discute sus afinidades morfológicas y sus parientes putativos.

Key words: IUCN Red List, Lamiaceae, Mesoamerica, *Salvia*.

Salvia L. (Lamiaceae) consists of at least 900 species and is almost cosmopolitan, with main centers of diversity in Southwest Asia and in Mexico and Central and South America (Harley, 2004). The *Flora Mesoamericana* region stretches from the Yucatán Peninsula and the Mexican state of Chiapas in the north to the Panamanian province of Darién in the south (Davidse, 1994), covering about 737,437 km^2 in total and with an estimated 17,300 plant species (Knapp et al., 2005). The total number of *Salvia* species in the *Flora Mesoamericana* region is 69 and includes ca. 250 to 300 names previously recognized within *Salvia*. The Chiapas and Guatemalan highlands answer for the highest diversity with about 60 species, while countries relatively lacking in high mountains, like Nicaragua and El Salvador, only have 20 species and 16 species, respectively.

Salvia officinalis L., native to the Mediterranean, is widely used as an herb in cooking; many species are ornamentals (e.g., *S. microphylla* Kunth and *S. splendens* Sellow ex Roemer & Schultes); and some have medicinal properties, e.g., *S. miltiorrhiza* Bunge is used in treatment of cardiac problems (Zhao et al., 1996; Wu et al., 1998; Takahashi et al., 2002).

The revision of *Salvia* subg. *Calosphace* (Bentham) Epling (Epling, 1939) plus nine supplementary papers (Epling, 1940, 1941, 1944, 1947, 1951, 1960; Epling & Mathias, 1957; Epling & Játiva, 1963, 1966) are by far the most comprehensive treatments of New World *Salvia* to date. Since 1939 several regional flora treatments were also published (Nowicke & Epling, 1969 (Panama); Standley & Williams, 1973 (Guatemala); Wood & Harley, 1989 (Colombia); Pool, 2001 (Nicaragua); and Domínguez et al., 2002 (Chiapas)). The *Flora Mesoamericana* treatment, for which this paper is a precursor, will be the most comprehensive treatment of New World *Salvia* since Epling's studies. While working on this treatment, the author examined more than 4000 herbarium specimens from the *Flora Mesoamericana* region, and three new species were revealed.

1. Salvia colonica Standley & Williams ex Klitgaard, sp. nov. TYPE: Honduras. Choluteca: road betw. Chinchayote & Comalí, 1100 m, 9 Nov. 1969, *A. Molina R. & A. Molina 24589* (holotype, F; isotype, MO). Figure 1P–X.

Salvia colonica Standley & Williams ex Klitgaard; species *S. comayaguanae* Standley similis, sed foliis late ovatis basi obtusis longe angustatis (haud ovatis vel ellipticis basi obtusis vel acutis vel breve angustatis), floribus 12–13 mm longis, albidis vel cyaneis (haud floribus 18–20 mm longis, purpureis) differt.

Erect, aromatic *shrub* to 1.5 m tall; *stems* purplish brown, with dense, white, multicellular, uniseriate trichomes and sessile orange glands. *Leaves* 4–10 × 2.5–6 cm, wide-ovate, membranous, the upper surface dark green, the lower surface pale green, both surfaces pubescent like the stems, the base long-decurrent, the margins serrate, the apex acuminate;

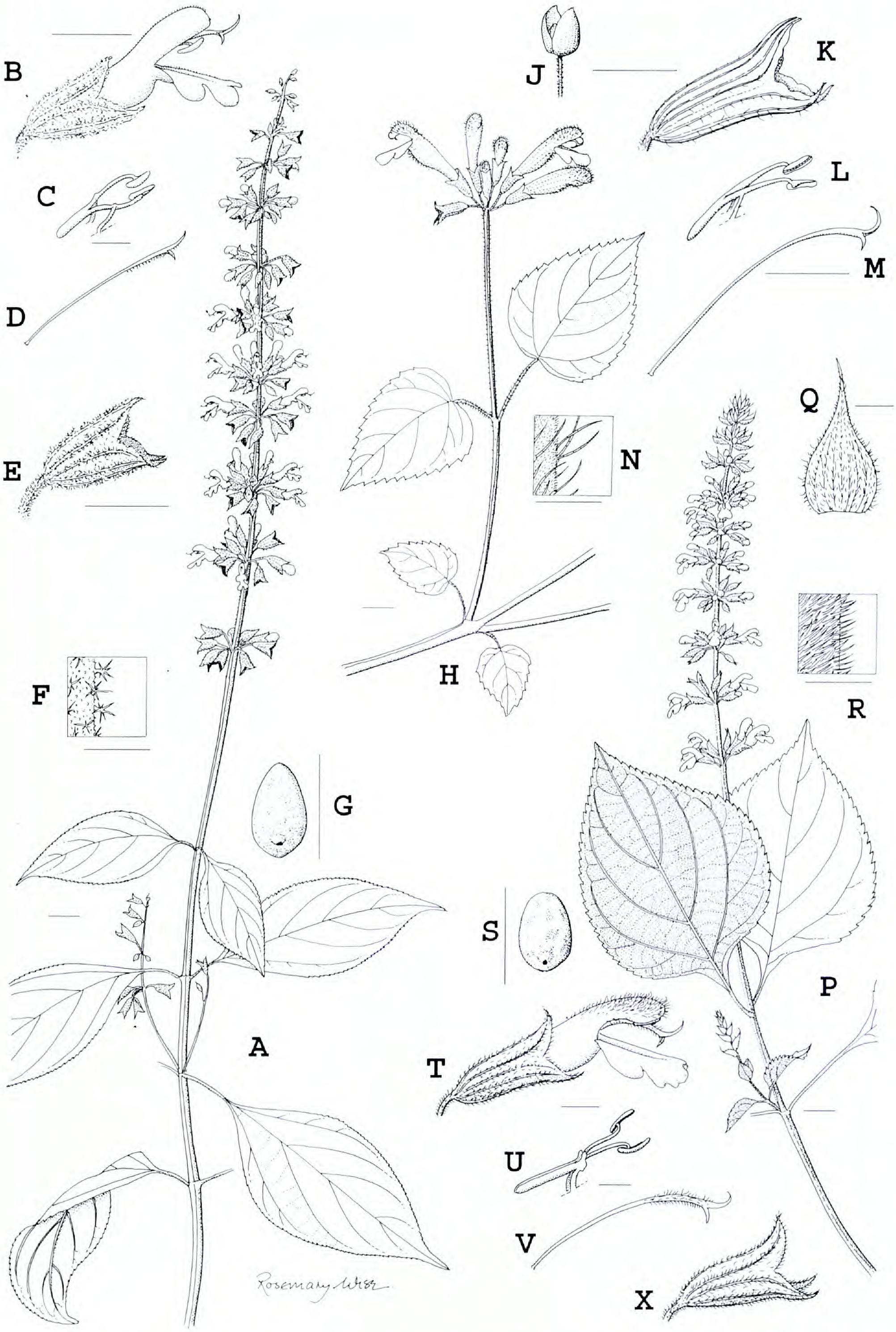

Figure 1. A–G. *Salvia whitefoordiae* Klitgaard. —A. Habit. —B. Flower. —C. Stamens. —D. Style. —E. Calyx. —F. Trichomes. —G. Nutlet. Drawn from *E. Cabrera et al. 1906* (MEXU). H–N. *Salvia univerticillata* Ramamoorthy ex Klitgaard. —H. Habit. —J. Bracts. —K. Calyx. —L. Stamens. —M. Style. —N. Trichomes. Drawn from *A. Shilom Ton 2001* (F). P–X. *Salvia colonica* Standley & Williams ex Klitgaard. —P. Habit. —Q. Bract. —R. Trichomes. —S. Nutlet. —T. Flower. —U. Stamens. —V. Style. —X. Calyx. Drawn from *A. Molina R. & A. Molina 24589* (F). Scale bars = 1 cm in A, B, E, H, L and M (shared), P; 0.5 cm in J and K (shared); 0.2 cm in C and D (shared), G, N, Q, R, S, T and U (shared), V and X (shared); 1 mm in F. Line drawing by Rosemary Wise.

petiole (5–)30–50 mm. *Inflorescences* 5–14 cm, the terminal long and axillary shorter, of dense 10- to 14-flowered verticillasters aggregated into spikes, verticillasters 3–10(–30) mm apart, basal one most distant; axes pubescent like the stems, but more densely; bracts 5–9 × 1.5–3 mm, decussate, ovate, the apex caudate, early caducous. *Flowers* 13–14 mm; bracteoles not seen; pedicels 2–5 mm; *flowering calyx* ca. 8 × 5 mm, 9-nerved (the 3 nerves running into the upper calyx lobe pronounced), campanulate, pubescent like the axes; upper lip ca. 3 mm, the apex triangular, mucronate; lower lip ca. 3 mm, 2-cleft for ca. 1.5 mm, the teeth triangular, the apices mucronate; fruiting calyx slightly accrescent, constricted apically; *corolla* 12–13 mm, white, blue, or blue with a white throat; tube 7–8 mm, glabrous, ventricose below the lower lobe, expapillate, exannulate; upper lip 5–6 mm, hooded, densely pubescent with multicellular trichomes; lower lip 3-lobed, 7–8 × 6–7 mm, reflexed, the lateral lobes pendent, the central lobe largest, the central and lateral lobe margins overlapping; *stamens* ca. 9 mm, included, inserted at the rim of the corolla tube; fertile thecae per stamen 1; connectives of the aborted thecae ca. 4 × 1 mm, expanded, fused, spathulate, toothed ca. 4 mm from the base; *style* ca. 14 mm, exserted, pubescent like the upper corolla lip along its entire length; stigma 2-lobed, pubescent like style, except the stigmatic surface, the adaxial lobe ca. 2 mm, the abaxial lobe ca. 1 mm. *Nutlets* ca. 1.3 × 1 mm, triangular, smooth, speckled green and rusty brown.

Salvia colonica flowers in October and in February to April, and fruit set is observed in October, February to April, and May. The species occurs in Costa Rica, Honduras, and Nicaragua between 700 and 1300 m, occasionally at 2000 m above sea level. It is abundant in secondary pine–oak forests and along roadsides and rivers. Because *S. colonica* is widely distributed, the preliminary conservation assessment places *S. colonica* in the Least Concern (LC) category. Continued habitat destruction throughout its geographical range in the near future, however, may warrant a change in conservation status to the Near Threatened (NT) category (IUCN, 2001).

The species is similar to *Salvia comayaguana* Standley (endemic to Comayagua, Morazán, and Intibuca in Honduras), which has ovate or elliptic leaves with obtuse to acute or short-decurrent bases (vs. wide-ovate leaves with long-decurrent bases in *S. colonica*) and 18–20 mm purple flowers (vs. 12–13 mm blue or white flowers in *S. colonica*).

Standley, in his protologue, notes that *Salvia comayaguana* is similar to *S. lindenii* Bentham. *Salvia lindenii* is a synonym of *S. karwinskii* Bentham (Epling, 1939; Standley & Williams, 1973).

Paratypes. COSTA RICA. **Puntarenas:** Monteverde, 20 Feb. 1980, *W. A. Haber 369* (MO); Cordillera de Tilarán, San Luis, 2 km from the crossing to Santa Elena, 7 Mar. 1994, *J. F. Morales 2434* (INB, MO). **San José:** Cantón de Aserri, 12 Dec. 1996, *J. Gonzalez, B. Hammel & J. F. Morales 1326* (INB, MO). HONDURAS. **Choluteca:** Sierra de Colón near San Francisco, 5 Nov. 1946, *L. O. Williams & A. Molina R. 10798* (F); road betw. El Espinoso & San Marcos de Colón, *A. Molina R. 23221* (F); vic. of San Marcos de Colón, 12–22 Jan. 1949, *P. C. Standley 15688* (F). NICARAGUA. **Estelí:** El Bosque archeological site, 10 km SW of Pueblo Nuevo, 1 Nov. 1976, *D. Neill 1211* (MO); along new road from Hwy. 1 to San Nicolas, 31 Aug. 1978, *W. D. Stevens 10314* (MO). **León:** betw. El Portillo & Quebrada de Agua, 21 Sep. 1980, *W. D. Stevens & O. M. Montiel 17905* (CAS, MO).

2. Salvia univerticillata Ramamoorthy ex Klitgaard, sp. nov. TYPE: Mexico. Chiapas: Mpio. La Independencia, third ridge along logging road from Las Margaritas to Campo Alegre, 27 Nov. 1980, *D. E. Breedlove & F. Almeda 47856* (holotype, MEXU; isotypes, CAS, MO). Figure 1H–N.

Salvia univerticillata Ramamoorthy ex Klitgaard: species forma florum sectionis *Cardinalium* Epling speciebus *S. ernesti-vargasii* C. Nelson et *S. karwinskii* Bentham et *S. wagneriana* Polakowski et *S. holwayi* S. F. Blake conveniens, forma foliorum sectionis *Fulgentium* Epling speciebus *S. pulchella* DC. et *S. fulgente* Cavanilles conveniens, sed inflorescentia univerticillata calycis dentibus brevibus obtusis insigniter differt.

Erect perennial *herb* to 90 cm tall; *stems* dark green, with dense white glandular trichomes interspersed with short, orange gland-tipped trichomes and 1.5–2.5 mm transparent multicellular trichomes. *Leaves* 2.7–8 × 1.7–6 cm, ovate or cordate, membranous, the upper surface dark green, the lower surface pale gray-green, the venation of both surfaces pubescent like the stems, the lamina with trichomes like the stems above and below, with dense brown sessile glands below, the base rounded or cordate, the margins dentate, the apex acute; petiole (7–)15–45(–60) mm. *Inflorescences* usually at one node, ca. 0.5 cm, terminal, verticillaster 5- to 8-flowered, occasionally with 2 verticillasters ca. 3 cm apart; axes when present violet, pubescent like the stems; bracts ca. 21 × 16 mm, decussate, wide-ovate, the base truncate, early caducous. *Flowers* 29–37 mm; bracteoles not seen; pedicels 4–6 mm; *flowering calyx* 9–11 × 6–7 mm, 15-nerved (the 7 nerves running into the upper lobe not pronounced), campanulate, pubescent like the axes; upper lip ca. 3 mm, triangular, apex mucronate; lower lip ca. 3 mm, 2-cleft for 2 mm, the teeth triangular, the apices cuspidate; fruiting calyx not accrescent, constricted apically; *corolla* 27–35 mm, bright red; tube 20–26 mm, glabrous, ventricose ca. 4 mm from the base, exannulate, with a frilly blade-shaped papilla at ca. 4 mm, and

2 club-shaped projections at ca. 18 mm; upper lip 7–9 mm, hooded, densely pubescent with ca. 1.5 mm red/transparent striped trichomes; lower lip 3-lobed, 8–10 × 7–8 mm, reflexed, the lateral lobes pendant, the central lobe largest; *stamens* 16–19 mm, included, inserted at ca. 2 mm below the rim of the corolla tube; fertile thecae per stamen 1; connectives of the aborted thecae ca. 11 × 2 mm, expanded, fused, toothed ca. 8 mm from the base; *style* 29–37 mm, exserted, glabrous; stigma 2-lobed, glabrous, the adaxial lobe 3–4 mm, the abaxial lobe ca. 1 mm. *Nutlets* ca. 3.2 × 2 mm, flattened, smooth, shiny, dark chocolate brown.

Salvia univerticillata flowers in May, August, and October to March, and fruit set is observed in March. The species has been collected in the central part of Chiapas state in Mexico. It occurs between 1980 and 3000 m above sea level, in primary and disturbed cloud forest with *Quercus* L., *Pinus* L., *Magnolia* L., *Podocarpus* Persoon, and *Olmediella* Baillon. *Salvia univerticillata* is a narrow endemic that grows in very vulnerable habitats. The preliminary conservation assessment of *S. univerticillata* thus places the species in the Vulnerable (VU) category (IUCN, 2001).

The new species shares its floral form with that of other members of section *Cardinales* such as *Salvia ernesti-vargasii*, *S. karwinskii*, *S. wagneriana*, and *S. holwayi*, and the leaf shape with that of *S. pulchella* and *S. fulgens* (both recognized in section *Fulgentes*), but it is uniquely defined by possessing univerticillate inflorescences with the occasional occurrence of two verticillasters per inflorescence, and calyces with relatively short, blunt teeth.

T. Ramamoorthy first recognized that *Salvia univerticillata* represented a new species. He annotated *Breedlove 33513* (MEXU) as a holotype in 1986, but he never published the name. From the same locality is *Breedlove 47856*, which is more complete and more widely distributed in herbaria, and I have therefore selected it as the type.

Paratypes. MEXICO. **Chiapas:** Mpio. Chanal, 4.7 km E of Carmen Yalchuch, 16 Mar. 1995, *H. Mejía E., A. Chamé O. & A. Luna G. 115* (MEXU); Mpio. La Independencia, third ridge along logging road from Las Margaritas to Campo Alegre, 18 Feb. 1973, *D. E. Breedlove 33513* (CAS, MEXU), 6 May 1973, *D. E. Breedlove 34801* (CAS, MEXU, MO), 24 Oct. 1976, *D. E. Breedlove 41115* (CAS, MEXU, MO), 20 Nov. 1981, *D. E. Breedlove & B. Bartholomew 55681* (CAS, MEXU); Mpio. Tenejapa, W of Tenejapa Center, along trail to Paraiso, 5 Aug. 1964, *D. E. Breedlove 6863* (CAS, F); Colonia Achlum, 10 Feb. 1981, *D. E. Breedlove 49748* (CAS, MEXU), 12 Dec. 1966, *A. Shilom Ton 1743* (F), 7 Feb. 1967, *A. Shilom Ton 2001* (F).

3. Salvia whitefoordiae Klitgaard, sp. nov. TYPE: Belize. Cayo: New Maria Camp, 550 m, 20 Apr. 1995, *C. Whitefoord 9100* (holotype, BM; isotype, K). Figure 1A–G.

Salvia whitefoordiae Klitgaard; species pilis dendriticis *S. karwinskii* Bentham et *S. ernesti-vargasii* C. Nelson conveniens, sed floribus purpureis brevioribus, inflorescentia longiora differt.

Erect aromatic, woody-based, perennial *herb* to 2 m tall; *stems* and *leaf venation* sometimes turning violet; stems usually appearing grayish brown with sparse to dense pubescence from multicellular, uniseriate white trichomes and sessile orange glands. *Leaves* (3.3–)5–10(–15) × (0.8–)2.5–4(–6) cm, smallest on axillary inflorescence-bearing branches, elliptic or lanceolate, membranous, the upper surface dark green, the lamina with sparse multicellular, uniseriate trichomes and orange sessile glands, the lower surface dull white, pubescence like the upper surface, denser, the base decurrent, the margins serrate, the apex acuminate or acute; petiole (5–)10–40(–50) mm. *Inflorescences* 10–60 cm, terminal and axillary, the terminal one larger, of dense 4- to 10(to 16)-flowered verticillasters aggregated into spikes, verticillasters 15–49 mm apart, the basal one most distant, otherwise verticillasters tightly packed; axes purple (Belize) or white (Chiapas) from dense violet/white or white dendritic trichomes, these interspersed with sessile orange glands; bracts 4–5 × 2 mm, decussate, wide-ovate, the base truncate, the apex caudate, green, sometimes turning violet, supporting verticillasters in bud. *Flowers* 8–9 mm; bracteoles 2–2.5 × 1–1.5 mm, shaped as the leaves, the margins serrate; pedicels 5–15 mm; *flowering calyx* 6–8 × 4 mm, 9-nerved (the 3 nerves running into the upper calyx lobe pronounced), tubular, whitish green or violet, with pubescence and glands similar to the axes; upper lip 2–4 mm, triangular, the apex caudate; lower lip 2.5–4 mm, 2-cleft for 0.5–1.5 mm, the teeth triangular, the apices mucronate; fruiting calyx accrescent, constricted apically; *corolla* 10–11 mm, purple, occasionally white; tube ca. 7 mm, glabrate, ventricose at ca. 2 mm and ca. 7 mm, with 2 invaginations below the lower lip, without papillae, exannulate; upper lip ca. 3 mm, hooded, the outer surface with ca. 0.2 mm white trichomes; lower lip 3-lobed, 3–4 × 3–4 mm, reflexed, the lateral lobes pendent, the central lobe cordate, larger than laterals; *stamens* ca. 5 mm, exserted above the corolla, the base inserted at the rim of the corolla tube; fertile thecae per stamen 1; connectives of the aborted thecae ca. 3 × 1.5 mm, expanded, fused, spathulate, toothed at ca. 3 mm; *style* 10.5–12 mm, exserted; stigma 2-lobed, minutely pubescent, the adaxial lobe 1.5–2 mm, the abaxial lobe ca. 0.5 mm. *Nutlets* ca. 1.8–2 × 1 mm, flattened, shiny green with dense brown speckles.

Salvia whitefoordiae flowers in December, January, and April, and fruit set is observed in January and March to May. The species has been collected in Belize (the districts of Cayo and Toledo) and the Mexican state of Chiapas (around La Trinitaria and Comitán, and between Ocinango and Palenque). It occurs between 488 (Belize) and 1600 m (Chiapas) above sea level, in primary and disturbed forest dominated by *Quercus*, *Pinus*, and *Liquidambar* L. species, or in forest clearings and along roadsides. Because *S. whitefoordiae* is widely distributed, the preliminary conservation assessment places *S. whitefoordiae* in the Least Concern (LC) category. Continued habitat destruction throughout its geographical range in the near future may, however, warrant that *S. whitefoordiae* change conservation status to the Near Threatened (NT) category (IUCN, 2001).

Salvia whitefoordiae shares dendritic trichomes with only two other Mesoamerican species: *S. ernesti-vargasii* and *S. karwinskii*. While *S. whitefoordiae*, for example, is covered in dendritic trichomes on inflorescence axes and calyces and has 8–9 mm purple flowers aggregated in inflorescences to 60 cm, *S. ernesti-vargasii* and *S. karwinskii* share dendritic trichomes on stems, leaves, inflorescence axes, and calyces and have 26–30 mm bright red flowers aggregated in inflorescences 10–18 cm.

The species was first recognized as new by T. Ramamoorthy (pers. obs. on label notes) but never published. Working on the *Salvia* treatment for *Flora Mesoamericana* has given the author access to much of the *Salvia* material available in the world's herbaria on loan; and since Thomas B. Croat's first collection was recorded in the 1970s, much additional material has been accumulated. This makes it a joy to finally describe this distinct species first pointed out to me by Caroline Whitefoord, one of the most careful observers of morphological characters and an important collector working in the Natural History Museum in London, who collected the plant herself on two occasions in Belize, and after whom *S. whitefoordiae* is named.

The label notes on *Méndez G. 8034* from Chiapas mention that the species is known as "sabal tz'ununtez" in the Tzeltal language.

Paratypes. BELIZE. **Cayo:** S of San Luis & E of Camp Six, 19 Mar. 1967, *J. Dwyer, T. Elias & R. Maxwell 362* (MO); 2.5 mi. past Guacamallo Bridge, road to Millionario, 29 Jan. 1974, *J. Dwyer & R. Liesner 12309A* (MO); Chiquibul, Monkey Trail, 8 Mar. 1996, *A. K. Monro, A. How & D. A. Sutton 1121* (BM, MO); along track betw. Las Cuevas & Monkey Trail, 16 Mar. 1999, *R. Rees, K. Sidwell, G. Reid & R. Sundin 137* (BM, MEXU, MO); track from Ceibo Chico to Ceibo Grande, 10 Mar. 2000, *M. Short, S. Cafferty, A. K. Monro, M. Peña-Chacorro & A. How 203* (BM, MEXU, MO). **Toledo:** Union Camp, 12 May 1979, *C. Whitefoord 1673* (BM). MEXICO. **Chiapas:** Mpio. Trinitaria, road La Trinitaria–Lagos de Monte Bello, 13 Apr. 1965, *D. E. Breedlove 9732* (CAS, MO); Monte Bello Nat. Park, E of Laguna Tzikaw, 23 Jan. 1973, *D. E. Breedlove & Smith* 32243 (CAS, MEXU); Monte Bello Natl. Park along road to Cinco Lagunas, 29 Jan. 1981, *D. E. Breedlove 49689* (CAS, MEXU); 25 E of Lagos de Monte Bello, 1 Mar. 1982, *E. Cabrera, E. Martinéz & H. de Cabrera 1838* (MEXU); on road pas Lagos de Monte Bello, 15.6 km E of jct. with blacktop, 27 Jan. 1979, *T. B. Croat 46608* (K, MEXU); Lagos Montebello, along gravel road from blacktop to Dos Lagunas, 3 mi. W of Dos Lagunas, 28 Jan. 1979, *T. B. Croat 46664* (K); road toward Cinco Lagos, at 800 m to the N, 6 Mar. 1995, *H. Mejía E. & A. Luna 61* (MEXU); road La Trinitaria–Cuautemoc, 25 Jan. 1985, *A. Méndez G. 8034* (MEXU); Cuautemoc, 20 km from Montaña Alta, 15 Mar. 1986, *A. Méndez G. 8898* (MEXU); 3.5 km E of Tziscao, on road Lagunas de Monte Bello–Bonampak, 8 Apr. 1983, *O. Téllez V. & J. L. Villaseñor R. 6612* (MO); Mpio. Ocosingo, road Ocosingo–Palenque, 3 March 1982, *E. Cabrera, E. Martinez & H. de Cabrera 1906* (MEXU).

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Solanum coalitum (Solanaceae), a New Endemic Species from Southern Ecuador

Sandra Knapp

Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom. sk@nhm.ac.uk

Abstract. A new endemic species of *Solanum* L. sect. *Holophylla* (G. Don) Walpers s.l. is described from Ecuador: *Solanum coalitum* S. Knapp is only known from the páramo of Cerro Toledo in Parque Nacional Podocarpus in the province of Loja. *Solanum coalitum* had been confused with the more widespread *S. stenophyllum* Dunal; its differences from that species are detailed and its species group membership and potential relationships within section *Holophylla* are discussed. The species is illustrated and given a preliminary conservation assessment of Endangered.

Resumen. Se describe una especie nueva de *Solanum* L. sección *Holophylla* (G. Don) Walpers s.l. endémica del Ecuador: *Solanum coalitum* S. Knapp se conoce únicamente del páramo del Cerro Toledo en el Parque Nacional Podocarpus en la provincia de Loja. *Solanum coalitum* ha sido confundida con *S. stenophyllum* Dunal, una especie de distribución más amplia; se detalla sus diferencias con esa especie y se discute el grupo de especies al que pertenece y las relaciones potenciales dentro de la sección *Holophylla*. Se ilustra la especie y se le atribuye un estado de conservación preliminar de En Peligro.

Key words: Biodiversity, Ecuador, endemic, IUCN Red List, *Solanum*.

Solanum L., with ca. 1500 species, is the largest genus in the Solanaceae and one of the 10 most species-rich genera of flowering plants (Frodin, 2004). The highest species diversity in the genus occurs in South America and is concentrated in the Andes (Knapp, 2002). As part of the collaborative project "PBI Solanum: A world-wide treatment" (see Knapp et al., 2004; <http://www.nhm.ac.uk/solanaceaesource>), descriptions of all species of *Solanum* are being provided online. This intensity of work in the genus by a large number of collaborators, coupled with the massive increase in specimens available from the Andean regions of South America, has meant that many new taxa are being discovered (Knapp, 2005; Granados-Tochoy & Orozco, 2006; Nee et al., 2006; Granados-Tochoy et al., 2007). In addition, the intensive global monographic project, in conjunction with the community commitment to achieving Targets 1 (a global plant species checklist) and 2 (preliminary conservation assessments for all known plant species) of the *Global Strategy for Plant Conservation* (GSPC; Secretariat of the CBD, 2002), means that recognition and description of endemic taxa or those facing a significant conservation threat is particularly timely. The description of taxa from protected areas is important to help conservation efforts in these habitats; knowledge of endemic species helps to strengthen the political case for government investment in protected areas management in the species-rich tropics.

The *Solanum nitidum* Ruiz & Pavón species group of section *Holophylla* (G. Don) Walpers s.l. was monographed almost 20 years ago (Knapp, 1989). As part of a re-examination of the boundaries and composition of section *Holophylla* s.l., this new species from the high elevations of southern Ecuador was revealed. Unfortunately, its identity was not confirmed until after the Red List for Ecuadorian endemics went to press (Knapp et al., 2007), but it boosts the number of endemic *Solanum* species in Ecuador from 26 to 27.

Solanum coalitum S. Knapp, sp. nov. TYPE: Ecuador. Loja: Yangana–Valladolid, km 1.1, track to Sierra Toledo, Km 18.5, 3250 m, ca. 4°23′S, 79°06′W, 14 Nov. 1997, *G. Lewis & B. Klitgaard 3719* (holotype, LOJA; isotypes, AAU, BM, K, QCA, QCNE). Figures 1, 2.

Haec species *Solano stenophyllo* Dunal similis, sed suffrutibus nanis vel serpentibus, caulibus et foliis plerumque glabris sed interdum superficie adaxiali foliorum ad margines revolutos et caulibus juvenilibus trichomatibus albis laxe ramosis vestitis, floribus maioribus, differt.

Subshrubs to 1 m, sometimes lax and trailing; stems glabrous and shining, usually appearing warty from the prominent leaf scars; young stems completely glabrous or sometimes with a few scattered loose branched trichomes to 0.5 mm, white; bark of older stems dark brown, shining; sympodial units plurifoliate, monopodial. Leaves simple, 2.5–10.4 × 0.7–3.5 cm, narrowly elliptic to less commonly elliptic,

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FLORA OF ECUADOR
G. P. Lewis & B. B. Klitgaard
3719
Solanum
Solanaceae
Province: Loja
Yangana–Valladolid, km1.1; track to Sierra Toledo, km18.5.
3250 m c.79° 06' W ; 4° 23' S 14 November 1997
Vegetation: shrub paramo on rocky slopes.
Shrub, 50 - 75 cm; leaves membranaceus,discolorous, dark green slightly glossy above, paler yellowish green and dull below; calyces glossy black, corollas dark mauve-lavender, anthers yellow, style white, stigma pale green; globose fleshy fruits black. Trackside scrub and rarer in paramo. Uncommon.
Field work funded by Carlsberg Foundation & Royal Botanic Gardens, Kew

Figure 1. Isotype specimen of *Solanum coalitum* S. Knapp (*Lewis & Klitgaard 3719*, BM).

the upper surface glabrous and shiny, sometimes with scattered branched white trichomes at the edge where the margin is revolute, the lower surface glabrous or sparsely papillate, the papillae drying reddish brown, perhaps glandular, the base acute to attenuate, the margins strongly revolute, pubescent adaxially where turned under, the apex acute; primary veins 5 to 10 pairs, drying darker than the lamina; petiole 0.3–1.6 cm, glabrous and shiny. Inflorescences terminal, 2.5–6(–10) cm, branched 4–6 times, with 3 to 15(to

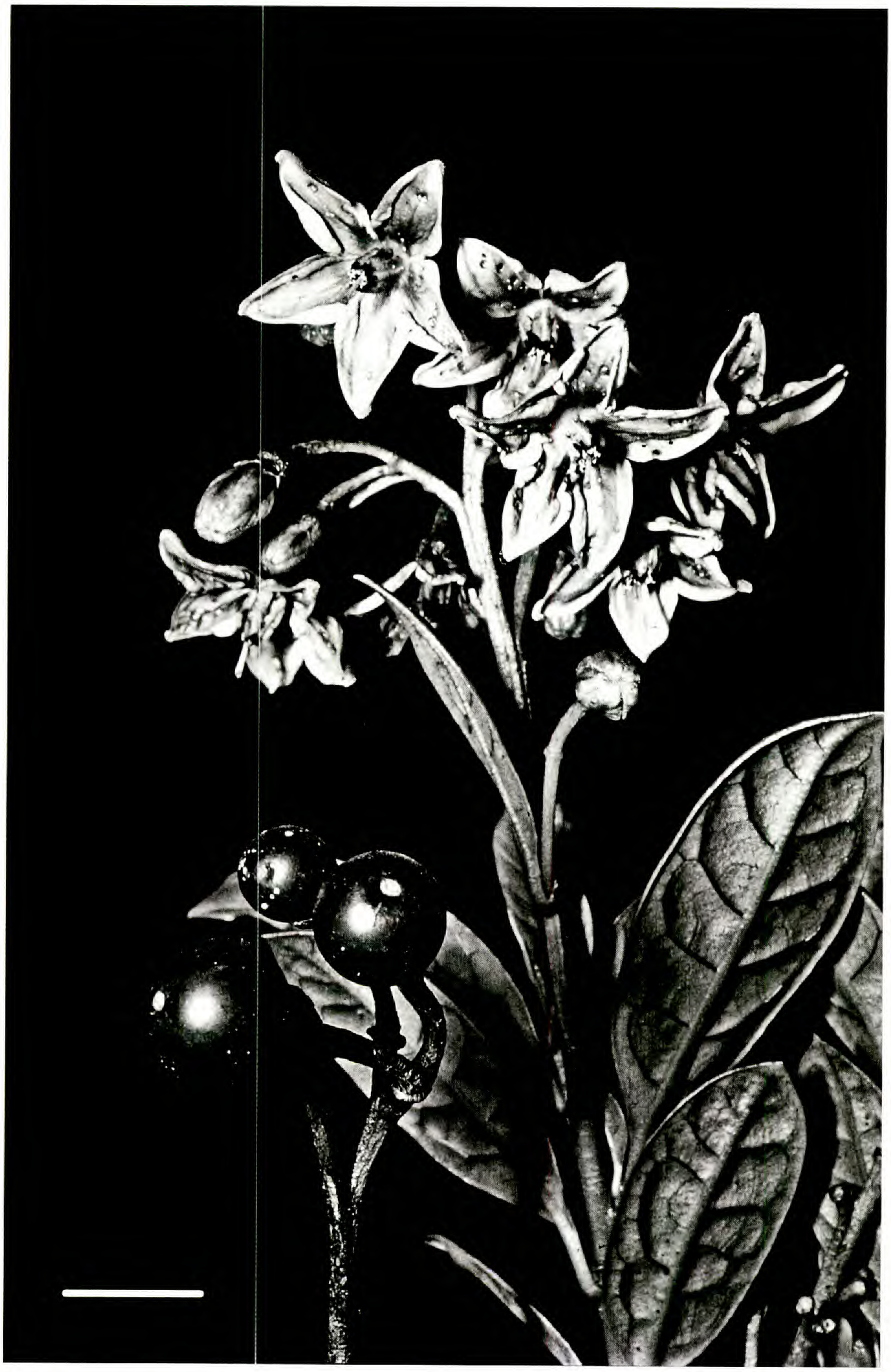

Figure 2. Shoot of *Solanum coalitum* S. Knapp with flowers and fruit (*Lewis & Klitgaard 3719*, Cerro Toledo, Loja, Ecuador). Scale bar = 1 cm. Photograph reproduced with permission of G. Lewis.

20) flowers, glabrous and shining, or with scattered loosely branched trichomes along the axes, the peduncle 2–4(–5.5) cm; pedicels in flower 0.8–1.3 cm, stout, ca. 1 mm diam. at the base, ca. 2 mm diam. at the apex, nodding, glabrous, minutely papillate or sparsely pubescent with loosely branched white trichomes ca. 0.3 mm; pedicel scars widely spaced, inserted in a short sleeve ca. 1 mm long; buds globose when very young, soon elliptic and strongly exserted from the calyx tube. Flowers all perfect; calyx with the tube 2.5–4 mm, cup-shaped, strongly constricted at base, thick and coriaceous, glabrous or with a few branched trichomes like those of the inflorescence axis, the lobes 1–1.5 mm, broadly deltate or minute, glabrous, with margins glabrous or densely pubescent with branched trichomes ca. 0.3 mm; corolla 2–2.6 cm diam., violet to dark mauve-purple, lobed 3/4 to base, stellate, the lobes 0.9–1.3 × 0.5–0.8 cm, slightly campanulate or planar at anthesis, densely pubescent with simple or dendritic trichomes ca. 0.5 mm long on margins and tips, sometimes with scattered simple trichomes on

adaxial lobe surface, these denser on the petal midvein, the abaxial surface glabrous; anthers 5–6 × 1.5–2 mm, the free portion of the filaments 1–1.5 mm, the filament tube less than 0.5 mm, glabrous; ovary conical, glabrous; style 1–1.2 cm, straight, glabrous; stigma clavate or 2-lobed, bright green (fide *Lewis & Klitgaard 3719*), the surface minutely papillate. Fruit a globose berry, 1.2–1.5 cm diam., shiny and black when mature, the pericarp thin; fruiting pedicels 2–2.2 cm, 2–2.5 mm diam. at the base, 2–3 mm diam. at the apex, erect, thick and woody; seeds 4–5 × 3–4 mm, flattened reniform, reddish brown, margins not enlarged, surfaces minutely pitted, testal cells sinuate in outline. Chromosome number: not known.

Distribution. *Solanum coalitum* is endemic to Ecuador, known only from the páramo of Cerro Toledo south of Loja along the road leading to the Peruvian border, on ridges between the towns of Yangana and Valladolid, at 3150–3460 m in the southwestern corner of Parque Nacional Podocarpus.

Phenology. *Solanum coalitum* has most often been collected in flower between October and December, during the dry season. All specimens are in flower, but the type is the only collection with mature fruits. It is likely that fruiting material will be found in January or February.

Etymology. *Solanum coalitum* is named in honor of two botanical couples, Gwilym Lewis (K) and Bente Klitgaard (BM), who collected the type specimen, and Peter Jørgensen and Carmen Ulloa (both MO), who collected one of the paratypes. They are sterling examples of strong and companionable botanical partnerships (from "coalitus," Latin for communion or fellowship).

Solanum coalitum is a striking species with its large, fleshy, bright purple flowers and black fruits (see Fig. 2). It is a member of the *S. nitidum* species group (sensu Knapp, 1989), sharing with the other species in that group plurifoliate sympodial units, monochasial growth, large purple or violet flowers, and pedicels inserted into a distinct "sleeve" (see fig. 2 in Knapp, 1989). Genus-wide phylogenetic studies using a variety of molecular markers (Bohs, 2005; Weese & Bohs, 2007) have shown that the species of this group are part of a monophyletic group containing taxa related to *S. dulcamara* L. (bittersweet) and a wide variety of other species with worldwide distribution (the Dulcamaroid clade of Bohs, 2005). The recognition of *S. pubigerum* Dunal (Mexico to Costa Rica) and *S. aligerum* Schlechtendal (Mexico to Argentina) as sister taxa of the *S. nitidum* species group (Knapp, 1989) has been supported by molecular data (Bohs, 2005). *Solanum valdiviense* Dunal (coastal southern Chile) is also a member of this larger group. Together these species can be defined as section *Holophylla* s.l. Ecuador is home to three endemic species of the *S. nitidum* species group (*S. leiophyllum* Bentham, *S. imbaburense* S. Knapp, and *S. coalitum*).

Some specimens of *Solanum coalitum* have been identified as *S. stenophyllum* Dunal, with which it is very similar. *Solanum coalitum* differs from *S. stenophyllum* in its subshrub, sometimes trailing habit, its glabrous stems and leaves (except, occasionally, for the occurrence of white trichomes on the stems and a peculiar marginal white trichome band on the leaves), its cyathiform (rather than conical) calyx, and its slightly larger flowers that are glabrous abaxially. Trichomes of *S. coalitum* when they occur are looser and more openly dendritic than the almost echinoid trichomes of *S. stenophyllum* that are distinctly yellow or yellow-tinged when dry. The fruiting pedicels of *S. stenophyllum* appear to be nodding when fruit are mature, while those of *S. coalitum* are erect. Specimens of *S. stenophyllum* have been collected from the province of Loja (i.e., *Jørgensen et al. 477, 1068*, BM) from further north and at slightly lower (2600–3000 m) elevations in drier and/or degraded forests. *Solanum stenophyllum* grows as a shrub or small treelet, usually in disturbed situations. Some individuals of *S. stenophyllum* in southern Ecuador are very sparsely pubescent, but the conical calyx and yellowish, closely branched trichomes serve to distinguish these plants.

Solanum coalitum would key out with *S. leiophyllum*, *S. macbridei* Hunziker & Lallana (southern Peru and Bolivia), and *S. imbaburense* in the key in Knapp (1989), being distinguished from *S. imbaburense* by its broadly deltate, rather than long-triangular calyx lobes, and its leaves with sparsely papillate undersides.

Habitat. The sole locality in which *Solanum coalitum* has been encountered is the páramo of Cerro Toledo in the extreme southwestern corner of Parque Nacional Podocarpus, one of the largest protected areas in Ecuador. Cerro Toledo is a mixed páramo of tussock grasses and shrubby vegetation on the divide of the Cordillera de Sabanillas; the area is a pathway used by local people to take cattle from one drainage to another, and as such has a medium level of disturbance (Hofstede et al., 2002). Roads constructed by the military to allow access to radio towers have opened the area to others. Hofstede et al. (2002) suggested that the inhospitable nature of the climate in the region (wet, cold, and windy) will limit human incursion on a large scale. Cerro Toledo is isolated from other páramo regions of southern Ecuador, and represents one of the southernmost extensions of the páramo habitat in the Andes (Luteyn, 1999).

IUCN Red List category. The fact that *Solanum coalitum* occurs only within the boundaries of the Parque Nacional Podocarpus is good news for its ultimate protection and conservation, but its very restricted distribution in an isolated habitat means it certainly is of some conservation concern. Using the IUCN criteria (IUCN, 2001), I assess this species as having a preliminary conservation status of Endangered (EN) due to its restricted distribution of less than 100 km^2 in a fragmented and isolated habitat. Population-level data may reveal that the species is, in fact, Critically Endangered (CR), but this is currently not assessable from the available herbarium specimens.

Paratypes. ECUADOR. **Loja**: carr. Yangana–Toledo, *Jaramillo 10606* (AAU); road from Yangana to Cerro Toledo, Km 18–22 to the antennas, *Jørgensen, Ulloa & Caranqui 2188* (BM, MO, NY, QCA); Yangana–Cerro Toledo, páramo of Cerro Toledo, *Jørgensen & Madsen 65686* (AAU, BM, LOJA, QCA); Parque Nac. Podocarpus, Cerro Toledo, *Madsen, Bloch & Christensen 75641* (AAU, BM); Parque Nac. Podocarpus, Cerro Toledo, *Madsen, Bergman & Pedersen 86100* (AAU, MO), *Madsen 86333* (AAU, BM, QCNE); Parque Nac. Podocarpus, Cerro Toledo, E of Yangana, *Øllgaard, Laegaard, Thomsen, Korning & Illum* 58068 (AAU, MO); Parque Nac. Podocarpus, Cerro Toledo, wet páramo around radio station, *Øllgaard, Laegaard, Thomsen, Korning & Illum 58162* (AAU, BM, MO); Parque Nac. Podocarpus, páramo del cerro Toledo, *Palacios 12863* (MO).

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A New Combination for Hawksworth's Dwarf Mistletoe (Viscaceae)

Robert L. Mathiasen
School of Forestry, Northern Arizona University, Flagstaff, Arizona 86011, U.S.A.
Robert.Mathiasen@nau.edu

Abstract. Morphological and molecular analyses of Honduran dwarf mistletoe (*Arceuthobium hondurense* Hawksworth & Wiens) and Hawksworth's dwarf mistletoe (*A. hawksworthii* Wiens & C. G. Shaw bis) indicate these taxa are closely related but can be distinguished based on a few morphological differences. They can also be distinguished by their phenology and host range. Because there are only a few morphological differences between these dwarf mistletoes and because the DNA sequences that have been examined for them are nearly identical, Hawksworth's dwarf mistletoe is reclassified as a subspecies of Honduran dwarf mistletoe: *Arceuthobium hondurense* subsp. *hawksworthii* (Wiens & C. G. Shaw bis) Mathiasen.

Key words: *Arceuthobium*, Honduran dwarf mistletoe, Viscaceae.

Two of the rarest dwarf mistletoes known occur in Central America and southern Mexico: Honduran dwarf mistletoe (*Arceuthobium hondurense* Hawksworth & Wiens) and Hawksworth's dwarf mistletoe (*A. hawksworthii* Wiens & C. G. Shaw bis). Honduran dwarf mistletoe was described in 1970 from populations southeast of Tegucigalpa, Honduras (Hawksworth & Wiens, 1970), and for many years it was only known from two locations in Honduras (Hawksworth & Wiens, 1996). At one time it was thought to be in danger of extinction because of the extensive harvesting of Honduran pine forests (Hawksworth & Wiens, 1977, 1996), but it has now been found in Chiapas and Oaxaca, Mexico (Mathiasen et al., 2001, 2002b). However, its distribution in Honduras and southern Mexico is still poorly known, as it has only been discovered in five areas of Honduras, two in Chiapas, and two in Oaxaca (Beatty et al., 1998; Mathiasen et al., 2001, 2002b, 2003; Mathiasen & Melgar, 2006). It has also been recently reported from Nicaragua near the border with Honduras (Mathiasen et al., 2006).

Hawksworth's dwarf mistletoe is known only from the Mountain Pine Ridge Region (MPR) of western Belize (Wiens & Shaw, 1994; Mathiasen et al., 1999) and from one location in central Honduras (Mathiasen et al., 2002a). Hawksworth's dwarf mistletoe had been collected by various investigators from the MPR since 1959, but it was not described until 1994 (Wiens & Shaw, 1994). It was previously thought to represent disjunct populations of *Arceuthobium globosum* Hawksworth & Wiens (Hawksworth & Wiens, 1972) and later was classified as *A. aureum* Hawksworth & Wiens subsp. *aureum* (Hawksworth & Wiens, 1977). However, a detailed analysis of the MPR populations by Wiens and Shaw (1994) indicated these populations were distinct from the *A. aureum* subsp. *aureum* populations found in the western and central highlands of Guatemala; therefore, the Belizean populations were described as a new species: *A. hawksworthii*.

I have been collecting data on the morphological characteristics, flowering and seed dispersal periods, and host ranges of Honduran and Hawksworth's dwarf mistletoes since 1998 (Mathiasen et al., 1999; Mathiasen et al., 2003). Based on the morphological similarities between these dwarf mistletoes and recent molecular evidence that indicates nuclear ribosomal internal transcribed spacer and chloroplast *trnL* region sequences for these two taxa are nearly identical (Nickrent et al., 2004), there is now sufficient evidence to support the close taxonomic affinities of these dwarf mistletoes and to support a new combination for Hawksworth's dwarf mistletoe as a subspecies of *Arceuthobium hondurense*.

Arceuthobium hondurense Hawksworth & Wiens subsp. **hawksworthii** (Wiens & C. G. Shaw bis) Mathiasen, comb. nov. Basionym: *Arceuthobium hawksworthii* Wiens & C. G. Shaw bis, J. Idaho Acad. Sci. 30: 25. 1994. TYPE: Belize. Cayo District: Mountain Pine Ridge Region, 2.4 km S of Cooma Cairn Lookout, 940 m, 26 Feb. 1994, *Wiens & Shaw 7768* (holotype, US; isotypes, BRH, K, MO, UC).

Plants 9–34 cm in height (mean ca. 16 cm); basal diam. of dominant plants 2–8 mm (mean 3.8 mm); third internode length 6–21 mm (mean 12 mm) and 1.7–4.7 mm (mean 2.8 mm) wide; staminate and pistillate plants primarily green-brown, but some yellow-green or light green; staminate flowers primarily 3-partite, occasionally 4-partite, and rarely 2-partite, frequently dark red on adaxial surface of

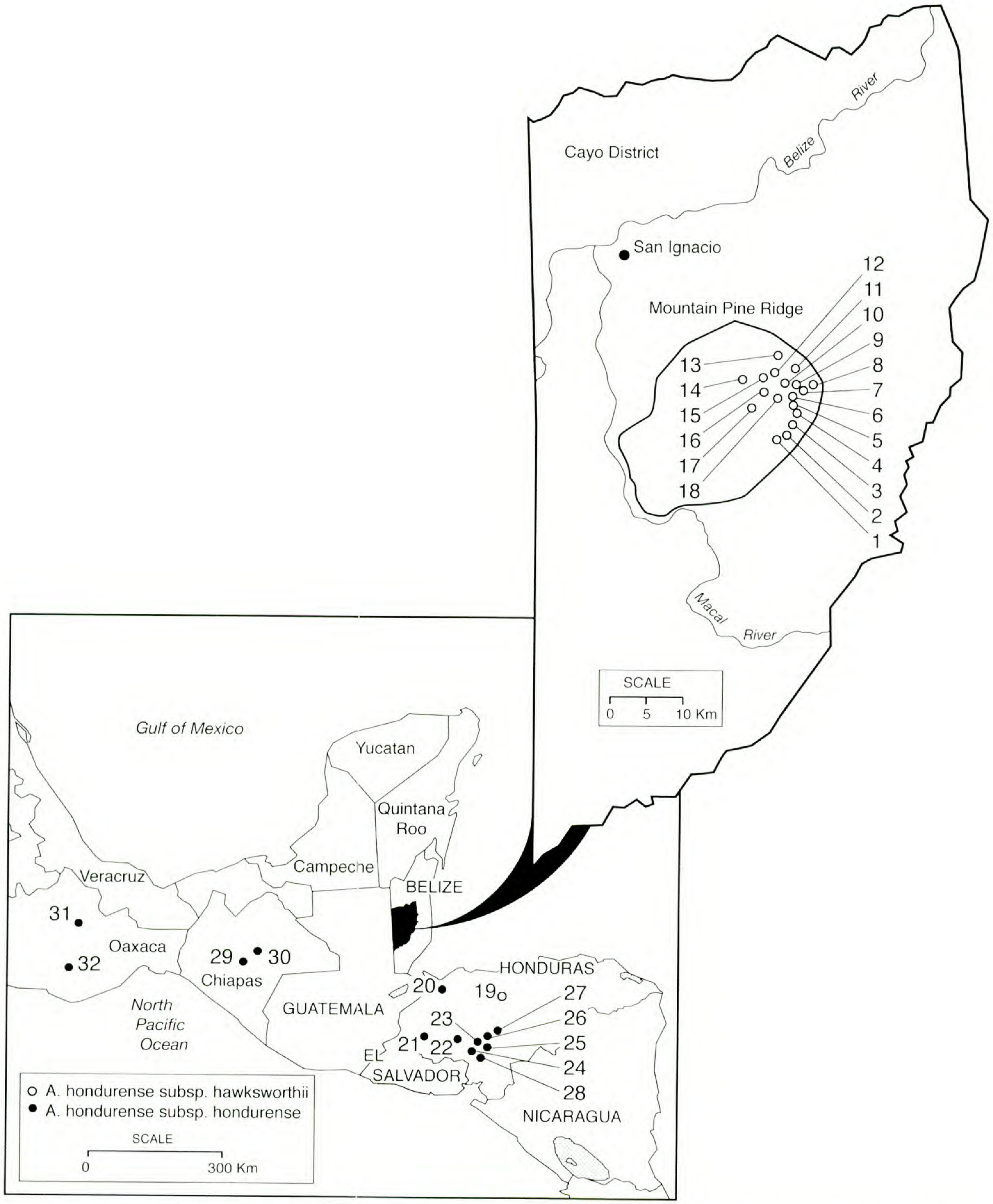

Figure 1. Approximate locations of populations sampled for *Arceuthobium hondurense* subsp. *hawksworthii* (open circles) in Belize and Honduras and for *A. hondurense* subsp. *hondurense* (dark circles) in Honduras and Mexico. BELIZE. Cayo District: Mountain Pine Ridge: —1. Lower Brunton Trail. —2. 2.5 km south of Cooma Cairn road on Brunton Trail. —3. Upper Brunton Trail. —4. 1.5 km south of Cooma Cairn road on Brunton Trail. —5. 1 km south of Cooma Cairn road on Brunton Trail. —6. Junction of Cooma Cairn road and Brunton Trail. —7. 2.2 km east of Cooma Cairn road on Baldy Beacon road. —8. 3.2 km east of Cooma Cairn on Baldy Beacon road. —9. 2.4 km north of Cooma Cairn on Cooma Cairn road. —10. 0.5 km south of Hidden Valley Falls road on Cooma Cairn road. —11. 1 km east of Cooma Cairn road on the road to Hidden Valley Falls. —12. Tiger Creek Falls overlook. —13. 1.2 km south of road to Hidden Valley Inn on Cooma Cairn road. —14. 0.4 km west of Cooma Cairn road on Thompson Line. —15. 5 km west of Cooma Cairn road on Orchid Hill Line. —16. 0.3 km west of Cooma Cairn road on Orchid Hill Line. —17. Lower Granite Cairn road. —18. 2 km east of Augustine road on the Oak Burn Line. HONDURAS. Department Olancho: —19. 10 km east of Gualaco on road to San Esteban. Department Cortes: —20. 4 km north of Buenos Aires on road into Cusuco National Park. Department Lempira: —21. Celaque National Park, 6 km

perianth lobes, but occasionally only the margins of lobes are red, and rarely lobes are the same color as the staminate plants, staminate flower diam. 2–3.6 mm (mean 2.8 mm); mature fruit length 3.9–5.2 mm (mean 4.6 mm) and 2.3–3.8 mm wide (mean 2.9 mm). Some mature fruits have slightly exserted stigmas (0.1–0.3 mm), but this character is variable. Fruits are markedly glaucous, but lose this character when dried. Seeds 2.6–3.4 (mean 3) mm long and 1–1.6 (mean 1.3) mm wide.

Sexual dimorphism between the male and female plants is extreme; male plants are openly branched and spreading while female plants are densely clustered with shorter internodes toward the terminus of plants.

Phenology. Anthesis from mid December through early March with the peak in mid January to early February; seed dispersal from mid November to early January with the peak in early December. Field observations indicate there are only one period of anthesis and one period of seed dispersal annually.

Habit. *Arceuthobium hondurense* subsp. *hawksworthii* is parasitic principally on *Pinus caribaea* Morelet var. *hondurensis* (Sénéclauze) W. H. Barrett & Golfari, but secondarily parasitic on *P. tecunumanii* Eguiluz & J. P. Perry.

Morphological Measurements

Eighteen populations of *Arceuthobium hondurense* subsp. *hawksworthii* were measured from Belize and one from Honduras (Fig. 1). Nine populations of *A. hondurense* have been sampled from Honduras and two populations each were sampled from Chiapas and Oaxaca, Mexico. From each population, 20 to 60 infections (10 to 30 males and 10 to 30 females) were collected and the tallest shoot from each infection was used for morphological measurements. Plant measurements were made within 24 hours of collection. The dwarf mistletoe plants were measured using digital calipers, a dissecting microscope with a micrometer, or a Bausch and Lomb 7× magnifying hand lens (Rochester, New York) with a micrometer.

The dwarf mistletoe plant characters measured were those used by Hawksworth and Wiens (1996) for taxonomic classification. The following morphological characters were measured: (1) height, basal diameter, third internode length and width, and color of the tallest male and female shoot from each infection collected; (2) mature fruit length, width, length of distal end, length of stigma, and color; (3) seed length, width, and color; (4) staminate flower diameter; (5) number, color of adaxial surface, length and width of staminate perianth lobes; (6) anther distance from the perianth lobe tip; and (7) anther diameter.

Physiological Data

Observations of flowering and seed dispersal for *Arceuthobium hondurense* subsp. *hawksworthii* were conducted during March, May, and August 1998; November 2000; February and December 2001; and January 2002 in Belize; and in November 2001 and September 2005 in Honduras. Observations were conducted for *A. hondurense* in March and August 1998; November 2000; March and December 2001; and in September 2005 in Honduras; in December 2000 in Oaxaca, Mexico; and in March 2000 and September 2005 and 2006 in Chiapas, Mexico.

Observations of host susceptibility were made in the field in Belize, Honduras, and southern Mexico. The principal host of Hawksworth's dwarf mistletoe in Belize and Honduras is *Pinus caribaea* var. *hondurensis*. In Belize it also infects *P. tecunumanii*, but this host is less susceptible to infection than *P. caribaea* and has been tentatively classified as a secondary host of Hawksworth's dwarf mistletoe (Mathiasen et al., 2003). Honduran dwarf mistletoe primarily parasitizes *P. oocarpa* Schiede ex Schlechtendal in Honduras, but it also severely parasitizes *P. tecunumanii* at two locations in Honduras: in Celaque and Cusuco National Parks (Mathiasen et al., 2000). In Mexico, its principal host is *P. tecunumanii*. Both dwarf mistletoes cause the stimulation of large witches' brooms on their hosts.

Molecular Data

Maximum parsimony analyses of nuclear ribosomal transcribed spacer (ITS) DNA sequences and chloroplast *trnL* region DNA sequences have demonstrated that *Arceuthobium hondurense* subsp. *hawksworthii* and *A. hondurense* are very closely related; they are

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south of Park Headquarters on trail to Campo Don Thomas. Department Francisco Morazan: —22. 5 km east of Lepaterique on road to Tegucigalpa. —23. 2.5 km from main highway to Tegucigalpa on road to La Estancia. —24. Junction of main highway to Tegucigalpa and road to Tatumbla. —25. 22 km southeast of Tegucigalpa on main highway to Zamorano. —26. 2 km south of Valle de Angeles on road to Tegucigalpa. —27. 7.5 km south of Valle de Angeles on road to Tegucigalpa. Department El Paraiso: —28. 22 km southwest of Zamorano on road to San Lucas. MEXICO. Chiapas: —29. 6.6 km west of San Cristobal de las Casas on Mexico Route 190. —30. 11 km west of Oxchuc on Route 186. Oaxaca: —31. 32 km east of Ixtlan on Route 175. —32. 1.4 km north of Suchixtepec on Route 175.

Table 1. Principal morphological and physiological differences between *Arceuthobium hondurense* subsp. *hawksworthii* and *A. hondurense* subsp. *hondurense*.

Characters	*A. hondurense* subsp. *hawksworthii*	*A. hondurense* subsp. *hondurense*
Mean plant height, cm		
Male	16.5	18.9
Female	15.8	25.8
Mean basal diam., mm		
Male	3.8	5.8
Female	3.7	5.2
Mean length and width of third internode, mm		
Male	12 × 2.6	15.6 × 3.8
Female	12.1 × 2.8	13.7 × 4.2
Mean flower diam., mm	2.8	2.5
Inside perianth lobe color	dark red to green	dark red
Mean fruit length and width, mm	4.6 × 2.9	5.4 × 3.5
Plant color		
Male	green-brown/green/yellow-brown	dark green-brown/black/green
Female	green/green-brown	dark green-brown/black
Host susceptibility[1]		
Pinus oocarpa	unknown	principal host
Pinus caribaea	principal host	unknown
Pinus tecunumanii	secondary host	principal host
Anthesis	December–March	August–November
Seed dispersal	November–January	September–October

[1] Host susceptibility system follows Hawksworth and Wiens (1972, 1996).

only separated by two base changes in their ITS sequences (Nickrent et al., 2004). Uncorrected "p" distances calculated using PAUP (Swofford, 2002) for these taxa were < 0.005 (Nickrent, unpublished data). These taxa are so closely related based on both ITS and *trnL* region DNA sequences, that Nickrent et al. (2004) considered them to be conspecific. Molecular data have also demonstrated that the southern Mexican populations sampled in this study are representative of Honduran dwarf mistletoe (Mathiasen et al., 2001, 2002a) and not black dwarf mistletoe (*A. nigrum* (Hawksworth & Wiens) Hawksworth & Wiens) as reported earlier by Hawksworth and Wiens (1977, 1996).

The principal morphological and physiological differences between *Arceuthobium hondurense* subsp. *hondurense* and *A. hondurense* subsp. *hawksworthii* are summarized in Table 1. Hawksworth and Wiens (1996: 146) defined subspecies in *Arceuthobium* as "geographically restricted populations delimited by a few relatively small but consistent variations." Whether or not the distributions of Hawksworth's dwarf mistletoe and Honduran dwarf mistletoe overlap in Honduras remains unknown, but their currently known distributions do not coincide. Furthermore, their range in elevation does not overlap: Hawksworth's dwarf mistletoe occurs between 500 and 1000 m in Belize and Honduras, while Honduran dwarf mistletoe occurs between 1200 and 1800 m in Honduras and 2400 to 3000 m in southern Mexico. These dwarf mistletoes have consistent morphological differences between them, have different flowering and seed dispersal periods, and parasitize different principal hosts: *Pinus oocarpa* versus *P. caribaea* (Table 1). However, they have many similar morphological characteristics, have nearly identical ITS and *trnL* region DNA sequences, and are capable of parasitizing *P. tecunumanii*, all of which clearly demonstrates that these mistletoes are closely related. Hence, the new combination: *A. hondurense* subsp. *hawksworthii* is proposed. Differences in plant size, phenology, and host range are the principal characters used by Hawksworth and Wiens (1972, 1996) to separate subspecies of *Arceuthobium*, and these are the suite of characters that distinguish Hawksworth's dwarf mistletoe from Honduran dwarf mistletoe.

Additional specimens examined. All citations based on *Pinus caribaea* var. *hondurensis*, except as noted. BELIZE. **Cayo District:** Mountain Pine Ridge, 2.4 km N of Cooma Cairn on Cooma Cairn rd., 1998, *Mathiasen 9802, 98101* (male & female) (ASC); 3.2 km E of Cooma Cairn on Baldy Beacon rd., 1998, *Mathiasen 9804* (male & female) (ASC);

1 km S of Cooma Cairn rd. on Brunton Trail, 1998, *Mathiasen 9817* (male & female) (ASC); 0.5 km S of Hidden Valley Falls rd. on Cooma Cairn rd., 1998, *Mathiasen 9819* (female) (ASC); jct. of Cooma Cairn rd. and Brunton Trail, 1998, *Mathiasen 9820* (male & female), on *P. tecunumanii*, *Mathiasen 9821* (male & female) (ASC); lower Brunton Trail, 1998, *Mathiasen 9822* (male & female) (ASC); lower Granite Cairn rd., 1998, *Mathiasen 9823* (male & female) (ASC); 2 km E of Augustine rd. on the Oak Burn Line, 1998, *Mathiasen 9824* (male & female) (ASC); upper Brunton Trail, 1998, *Mathiasen 9828* (female) (ASC); 1.2 km S of rd. to Hidden Valley Inn on Cooma Cairn rd., 1998, *Mathiasen 9833* (male & female) (ASC); Tiger Creek Falls overlook, 1998, *Mathiasen 9835* (male & female) (ASC); 0.3 km W of Cooma Cairn rd. on Orchid Hill Line, 1998, *Mathiasen 98102* (male & female) (ASC), on *P. tecunumanii*, *Mathiasen 98103* (male) (ASC); 5 km W of Cooma Cairn rd. on Orchid Hill Line, 1998, *Mathiasen 98104* (male & female) (ASC); 0.4 km W of Cooma Cairn rd. on Thompson Line, 1998, *Mathiasen 98105* (male & female) (ASC); 2.2 km E of Cooma Cairn rd. on Baldy Beacon rd., 2000, *Mathiasen 0044* (male & female) (ASC); 1.5 km S of Cooma Cairn rd. on Brunton Trail, 2001, *Mathiasen 0108* (male) (ASC); 1 km E of Cooma Cairn rd. on the rd. to Hidden Valley Falls, 2001, *Mathiasen 0141* (male & female) (ASC); 2.5 km S of Cooma Cairn rd. on Brunton Trail, 2001, *Mathiasen 0143* (male & female) (ASC). HONDURAS. **Department Olancho:** 10 km E of Gualaco on rd. to San Esteban, 2001, *Mathiasen 0133* (male & female) (ASC).

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Arceuthobium tsugense subsp. *amabilae*, a New Subspecies of Hemlock Dwarf Mistletoe (Viscaceae) from Oregon

Robert L. Mathiasen
School of Forestry, Northern Arizona University, Flagstaff, Arizona 86011, U.S.A.
Robert.Mathiasen@nau.edu

Carolyn M. Daugherty
Department of Geography, Planning, and Recreation, Northern Arizona University, Flagstaff, Arizona 86011, U.S.A.

Abstract. The dwarf mistletoe severely parasitizing Pacific silver fir in Oregon is described as a new subspecies of hemlock dwarf mistletoe. This classification is based on morphological and host range differences between hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosendahl) G. N. Jones subsp. *tsugense*, and the new subspecies, Pacific silver fir dwarf mistletoe, *Arceuthobium tsugense* subsp. *amabilae* Mathiasen & C. Daugherty.

Key words: *Arceuthobium*, Hemlock dwarf mistletoe, IUCN Red List, mountain hemlock, noble fir, Oregon, Pacific silver fir, Viscaceae, western hemlock.

The taxonomic classification of the dwarf mistletoes severely parasitizing Pacific silver fir (*Abies amabilis* Douglas ex J. Forbes) in Oregon and Washington has been unclear for many years (Hawksworth, 1987; Hawksworth & Wiens, 1972, 1996). These mistletoes were first classified by Gill (1935) as *Arceuthobium campylopodum* Engelmann f. *abietinum* (Engelmann) L. S. Gill. Gill based his classification of *A. campylopodum* on his host form concept, and all dwarf mistletoes found on Pacific silver fir were placed in the form that included parasites of *Abies* species (f. *abietinum*). In their monograph of *Arceuthobium* M. Bieberstein, Hawksworth and Wiens (1972) classified the dwarf mistletoe parasitizing Pacific silver fir in the Pacific Northwest as hemlock dwarf mistletoe (*Arceuthobium tsugense* (Rosendahl) G. N. Jones), whose principal host is western hemlock (*Tsuga heterophylla* (Rafinesque) Sargent). Hawksworth and Wiens noted that infection of Pacific silver fir by *A. tsugense* was most common when this tree was growing in close association with infected hemlocks. They also noted that many of the reports of fir dwarf mistletoe (*Arceuthobium abietinum* Engelmann ex Munz) on Pacific silver fir from Washington should be attributed to *A. tsugense*, and they did not consider *A. abietinum* to be a parasite of Pacific silver fir. Hawksworth and Wiens (1972) only included white fir (*Abies concolor* Lindley & Gordon), grand fir (*Abies grandis* (Douglas ex D. Don) Lindley), California red fir (*Abies magnifica* A. Murray), and noble fir (*Abies procera* Rehder) as hosts of *Arceuthobium abietinum* in Oregon; they included only grand fir in Washington.

Hawksworth (1987) summarized the taxonomy of *Arceuthobium tsugense* and separated this species into three different races: a western hemlock race, a shore pine race, and a mountain hemlock race. Hawksworth indicated that only the western hemlock race parasitized species of *Abies*. Hawksworth et al. (1992) presented another interpretation for the classification of *A. tsugense*. They described the western hemlock and mountain hemlock races proposed by Hawksworth (1987) as subspecies of *A. tsugense*: western hemlock dwarf mistletoe (*A. tsugense* subsp. *tsugense*) and mountain hemlock dwarf mistletoe (*A. tsugense* (Rosendahl) G. N. Jones subsp. *mertensianae* Hawksworth & Nickrent), but they maintained the dwarf mistletoe parasitizing shore pine (*Pinus contorta* Douglas ex Loudon var. *contorta*) as a race of subspecies *tsugense*. They reported that *A. tsugense* subsp. *mertensianae* was also a common parasite of Pacific silver fir, noble fir, and subalpine fir (*Abies lasiocarpa* (Hooker) Nuttall), but only where these hosts were associated with infected mountain hemlocks. Both subspecies of *A. tsugense* were considered to be principal parasites of Pacific silver fir and noble fir by Hawksworth et al. (1992).

In a revision of their monograph on *Arceuthobium*, Hawksworth and Wiens (1996) maintained the classification of *A. tsugense* as proposed by Hawksworth et al. (1992). However, Wass and Mathiasen (2003) classified the race of *A. tsugense* parasitizing shore pine in southern British Columbia and northwestern Washington as a subspecies of *A. tsugense*: *A. tsugense* subsp. *contortae* Wass & Mathiasen. Therefore, the most current classification of hemlock dwarf mistletoe consists of three subspecies: western

hemlock dwarf mistletoe (subsp. *tsugense*), mountain hemlock dwarf mistletoe (subsp. *mertensianae*), and shore pine dwarf mistletoe (subsp. *contortae*). The subspecies are primarily distinguished by differences in plant height, time of flowering and seed dispersal, and host range (Hawksworth et al., 1992; Hawksworth & Wiens, 1996; Wass & Mathiasen, 2003). Hawksworth and Wiens (1996) classified Pacific silver fir as a principal host of subspecies *mertensianae* and as a tentative principal host of subspecies *tsugense*. Mathiasen and Daugherty (2005) provided quantitative data demonstrating that Pacific silver fir is only an occasional host of subspecies *tsugense* in the Cascade Range of Oregon and Washington but reported that some large Pacific silver firs are severely infected when growing in close association with infected western hemlocks. The latter situation has resulted in confusion regarding the natural susceptibility of Pacific silver fir to subspecies *tsugense* in the Pacific Northwest.

In 1997, we began intensive studies of the morphology and host range of *Arceuthobium tsugense* throughout its geographic range. Based on this work, we describe the dwarf mistletoe commonly parasitizing Pacific silver fir in central Oregon as another subspecies of *A. tsugense*.

Arceuthobium tsugense (Rosendahl) G. N. Jones subsp. **amabilae** Mathiasen & C. Daugherty, subsp. nov. [Pacific silver fir dwarf mistletoe]. TYPE: U.S.A. Oregon: Linn County, Bunchgrass Mountain at jct. of forest roads 2655 and 503, Willamette Natl. Forest, parasitic on *Abies amabilis*, 44°18′59″N, 122°05′05″W, ca. 1380 m, 26 Sep. 2004, *R. L. Mathiasen & C. M. Daugherty 0462* (holotype, ASC; isotypes, MO, UC, US).

Plantae 6–18(10) cm altae; surculi principales basi 2–6(3.3) mm diam.; internodiis tertiis 7–26(14.4) mm longis, 2 mm latis; fructus maturi 4.7 × 3.1 mm; anthesis mense Julio–Septembri; fructus maturitas Septembri–Octobri; in *Abies amabilis* parasiticae.

Plants 6–18 cm in height (mean ca. 10 cm); basal diam. of dominant plants 2–6 mm (mean 3.3 mm); third internode length 7–26 mm (mean 14.4 mm) and 2 mm wide; staminate plants primarily green-brown, but some yellow-green; pistillate plants primarily green, but some green-brown or, rarely, yellow-green; staminate flowers 3- or 4-partite, flower diam. 2.5–5.8 mm (mean 3.5 mm); mature fruit length 3.2–6 mm (mean 4.7 mm) and 2.4–3.9 mm wide (mean 3.1 mm).

Phenology. Anthesis from mid July through mid September with peaks in late July to mid August; seed dispersal from early September to late October with peaks in late September to early October.

Habit. Parasitic principally on *Abies amabilis*, *A. procera*, and *Tsuga mertensiana* (Bongard) Carrière. Secondarily parasitic on *A. lasiocarpa*, occasionally parasitic on *T. heterophylla* and *A. lowiana* (Gordon) A. Murray, and rarely parasitic on *A. grandis* and *Pinus monticola* Douglas ex D. Don.

Distribution. *Arceuthobium tsugense* subsp. *amabilae* occurs in Oregon from near Mount Hood south through the western Cascade Range to ca. 13 km south of the Umpqua River in Douglas County. It is most common in the western Cascade Range of central Oregon south of Tombstone Summit on State Route 20 and north of the Calapooya Mountains. The population of dwarf mistletoe on noble fir near the summit of Mary's Peak in the Oregon Coast Range is considered to represent a western outlier of the Pacific silver fir dwarf mistletoe. Elevational range is from ca. 1100 m on Mary's Peak to as high as 1700 m on Warner Mountain in the western Cascade Range of south-central Oregon.

IUCN Red List category. Because *Arceuthobium tsugense* subsp. *amabilae* is distributed from northern Oregon near Mount Hood through the west side of the Cascade Range as far south as the Umpqua River in south-central Oregon, its IUCN Conservation Status is best represented as: Least Concern (IUCN, 2001). Our observations south of Tombstone Summit and north of the Calapooya Mountains divide indicate there are many populations of this dwarf mistletoe in this region, and many of the infested Pacific silver fir stands we have observed are severely infested. Many of the infected Pacific silver firs have hundreds of infections and mature plants on them. In addition, both noble fir and mountain hemlock are principal hosts of the dwarf mistletoe, and in several locations these hosts are severely infected as well. Because large-scale and intensive logging, including clearcutting, of these forests has been drastically curtailed in the past 10 years, it is not likely that populations of this dwarf mistletoe will be affected unless widespread and intensive logging of these forests resumes.

Pacific Silver Fir Dwarf Mistletoe

A total of 16 populations of *Arceuthobium tsugense* subsp. *amabilae* were sampled from within its geographic range in Oregon (Fig. 1). From each population, 20 to 40 infections were collected, and the dominant shoot from each infection was used for morphological measurements. For each population, 10 or 20 male and female infections were collected.

In order to make a comparison with the morphological characters of *Arceuthobium tsugense* subsp.

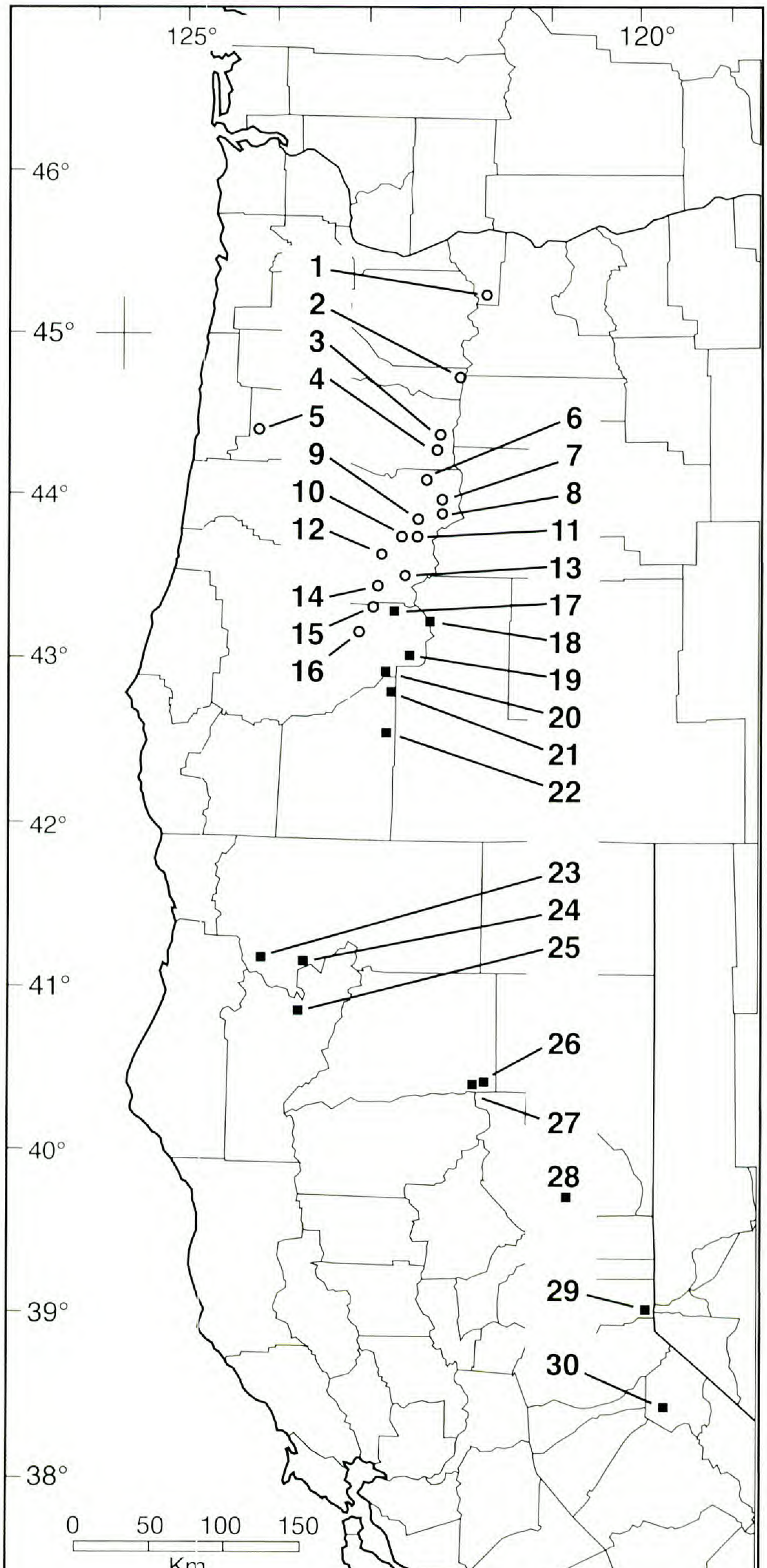

Figure 1. Approximate locations of populations sampled for *Arceuthobium tsugense* subsp. *amabilae* and *A. tsugense* subsp. *mertensianae* in Oregon and California. Open circles indicate populations of subspecies *amabilae*, and closed squares represent populations of subspecies *mertensianae*. OREGON: —1. Bennett Pass. —2. Skyline Road. —3. Wildcat Mountain. —4. Bunchgrass Mountain. —5. Mary's Peak. —6. Frissell Point. —7. Olallie Ridge. —8. Pat Saddle. —9. Lowell Mountain. —10. Huckleberry Mountain. —11. Blair Lake. —12. Holland Meadow. —13. Hemlock Butte. —14. Warner Mountain. —15. Staley Ridge. —16. Snowbird Camp. —17. Calapooya Ridge. —18. Windigo Pass. —19. Mount Thielsen Trail. —20. Beaver Meadow on State Route 230. —21. Huckleberry Campground. —22. Mount McLaughlin Trail. CALIFORNIA: —23. Chimney Rock. —24. Eaton Lake. —25. Snowslide Lake. —26. Kings Creek. —27. Diamond Peak. —28. Long Lake. —29. Alpine Meadows Ski Area. —30. Mosquito Lakes.

Table 1. Principal morphological and physiological differences between Pacific silver fir dwarf mistletoe (subsp. *amabilae*), western hemlock dwarf mistletoe (subsp. *tsugense*), and mountain hemlock dwarf mistletoe (subsp. *mertensianae*).

Characters	subsp. *amabilae*	subsp. *tsugense*	subsp. *mertensianae*
Mean plant height, cm			
Male	9.4	7.8	5.7
Female	10.6	8	6.1
Mean basal diam., mm			
Male	3.1	2.6	1.9
Female	3.4	2.7	2.2
Mean length of third internode, mm			
Male	12.6	11.8	8
Female	15	12.3	9.8
Mean flower diam., mm	3.5	3.6	2.7
Mean fruit length, mm	4.7	4.4	3.8
Plant color			
Male	green-brown/yellow-green/green	yellow-green	yellow-green/green-brown
Female	green/green-brown	yellow-green/purple	green-brown/green
Host susceptibility[1]			
Pacific Silver Fir	principal host	occasional host	immune
Western hemlock	occasional host	principal host	occasional host
Mountain hemlock	principal host	occasional host	principal host
Noble fir	principal host	occasional host	unknown
Western white pine	rare host	rare host	occasional host
Peak seed dispersal	2 weeks earlier than subsp. *tsugense*	2 weeks later than subsp. *amabilae* and subsp. *mertensianae*	2 weeks earlier than subsp. *tsugense*

[1] Host susceptibility system follows Hawksworth and Wiens (1972, 1996). Host classifications for subsp. *amabilae* are based on data from field observations. Host classifications for subsp. *tsugense* are based on data presented by Mathiasen and Daugherty (2005) and Shaw (1982). Host classifications for subsp. *mertensianae* are based on data from Mathiasen and Hawksworth (1988) and from field observations. Earlier classifications of Pacific silver fir and noble fir as principal hosts of subsp. *mertensianae* are based on the classification of subsp. *amabilae* as subsp. *mertensianae* in Oregon (Mathiasen, 1994; Hawksworth & Wiens, 1996).

mertensianae, a total of 14 populations of subspecies *mertensianae* were sampled from central and northern California and southern Oregon (Fig. 1). From each population, 20 to 40 infections were collected, and the dominant shoot from each infection was used for morphological measurements. For each population, 10 or 20 male and female infections were collected.

Morphological data for *Arceuthobium tsugense* subsp. *tsugense* were collected for a total of 20 populations from British Columbia (6 populations), Washington (6 populations), and Oregon (8 populations) by Wass and Mathiasen (2003). The subspecies *tsugense* populations had 10 male and 10 female infections sampled from each population.

The dwarf mistletoe plant characters measured were those used by Hawksworth and Wiens (1996) for taxonomic classification. The following morphological characters were measured: (1) height, basal diameter, third internode length and width, and color of the tallest male and female shoot from each infection collected; (2) mature fruit length, width, and color; (3) seed length, width, and color; (4) staminate flower diameter; (5) number, length, and width of staminate perianth lobes; (6) anther distance from the perianth lobe tip; and (7) anther diameter. Plants were measured within 24 hours after collection and were measured using a digital caliper, a dissecting microscope with a micrometer, or with a Bausch and Lomb 7× hand lens (Rochester, New York) equipped with a micrometer.

Plants of *Arceuthobium tsugense* subsp. *amabilae*, subspecies *tsugense*, and subspecies *mertensianae* appear morphologically similar, but they have several consistent morphological differences (Table 1). Male and female plants of subspecies *amabilae* are consistently larger than subspecies *tsugense* and much larger than subspecies *mertensianae*. In addition, the color of female plants of subspecies *amabilae* is frequently green or green-brown, while the color of female plants of subspecies *tsugense* is consistently yellow-green or purple (Hawksworth & Wiens, 1996; Wass & Mathiasen, 2003). Staminate flowers of

subspecies *amabilae* are similar in size to those of subspecies *tsugense*, but both of these subspecies have flowers that are consistently larger than the flowers of subspecies *mertensianae* (Table 1). Although Hawksworth et al. (1992) and Hawksworth and Wiens (1996) reported that staminate flower diameters of subspecies *mertensianae* are similar to those of subspecies *tsugense*, our measurements indicate that the staminate flowers of subspecies *mertensianae* are consistently smaller than those of the other subspecies.

The principal hosts of *Arceuthobium tsugense* subsp. *amabilae* are clearly Pacific silver fir, noble fir, and mountain hemlock, and western hemlock is only an occasional host using the host susceptibility system of Hawksworth and Wiens (1972, 1996) (Table 1). *Arceuthobium tsugense* subsp. *amabilae* severely parasitizes Pacific silver fir in several areas where noble fir and mountain hemlock are not present, which indicates that this dwarf mistletoe does not require all of its principal hosts to be present in an area to survive and spread. We have never found subspecies *amabilae* in a location parasitizing only mountain hemlock, however. But on Mary's Peak it does parasitize noble fir without Pacific silver fir or mountain hemlock present. Pacific silver fir, noble fir, and mountain hemlock have all been classified as occasional hosts of subspecies *tsugense* (Shaw, 1982; Mathiasen & Daugherty, 2005). Pacific silver fir has not been observed to be infected by subspecies *mertensianae* in central or southern Oregon, where Pacific silver fir commonly occurs near infected mountain hemlocks. Another host susceptibility difference between the subspecies of *A. tsugense* is that western white pine is an occasional host of subspecies *mertensianae* in southern Oregon and California, and at some locations large western white pines are severely infected (Mathiasen & Hawksworth, 1988). However, western white pine is only rarely infected by subspecies *amabilae* and subspecies *tsugense* in Oregon (Gill, 1935; Hawksworth & Wiens, 1996). Thus far, we have only found two cases of infection of western white pine by subspecies *amabilae* in central Oregon. The host susceptibility differences among Pacific silver fir, noble fir, mountain hemlock, and western hemlock to subspecies *amabilae*, *tsugense*, and *mertensianae* represent physiological discontinuities between these dwarf mistletoes that also have taxonomic significance.

Giving *Arceuthobium tsugense* subsp. *amabilae* taxonomic status at the subspecific level is consistent with the classification of the other subspecies of *A. tsugense* (Hawksworth et al., 1992; Wass & Mathiasen, 2003). Differences in plant size and host range have been the principal characters used to separate subspecies of *A. tsugense*, and these are the same characteristics that distinguish *A. tsugense* subsp. *amabilae* from subspecies *tsugense* and subspecies *mertensianae* (Table 1). Therefore, the classification of *A. tsugense* subsp. *amabilae* is consistent with the interpretation for *A. tsugense* proposed by Hawksworth et al. (1992) and Wass and Mathiasen (2003) and with the taxonomic framework established in Hawksworth and Wiens's 1996 monograph of *Arceuthobium*.

Paratypes. All citations based on *Abies amabilis* except as noted. U.S.A. **Oregon:** Hood River Co., Bennett Pass Sno-Park, 2004, *Mathiasen & Daugherty 0467* (female) (ASC), on *Tsuga mertensiana*, *Mathiasen & Daugherty 0468* (female) (ASC); Sahalie Falls below Mt. Hood Meadows Ski Area, 1991, *Mathiasen 9102* (UC), on *T. mertensiana*, 1991, *Mathiasen 9101* (UC); Marion Co., Skyline Rd. near N fork of Breitenbush River, 2004, *Mathiasen & Daugherty 0466* (male) (ASC), on *T. mertensiana*, 2004, *Mathiasen & Daugherty 0465* (male) (ASC); Linn Co., Wildcat Mtn., 1997, *Mathiasen 97158* (male) (ASC), 2004, *Mathiasen & Daugherty 0458* (female) (ASC), 1989, *Hawksworth 2355, 2357* (UC), on *A. procera*, 1997, *Mathiasen 97159* (male) (ASC), 1989, *Hawksworth 2356* (UC); Bunchgrass Mtn., 2004, *Mathiasen & Daugherty 0462* (female) (ASC), 2005, *Mathiasen & Daugherty 0557* (male) (ASC), on *A. procera*, 1998, *Mathiasen 98123* (male) (ASC), 2004, *Mathiasen & Daugherty 0463* (female) (ASC), 2005, *Mathiasen & Daugherty 0558* (male) (ASC), on *T. mertensiana*, 1997, *Mathiasen 97160* (male) (ASC), 2004, *Mathiasen & Daugherty 0464* (female) (ASC); Benton Co., Mary's Peak, on *A. procera*, 2004, *Mathiasen & Daugherty 0461* (female) (ASC); Lane Co., Frissell Point, 1989, *Hawksworth 2360* (UC), 1997, *Mathiasen 97162* (male) (ASC), 2004, *Mathiasen & Daugherty 0425* (male), *0456* (female) (ASC), on *A. procera*, 1989, *Hawksworth 2361* (UC), 2004, *Mathiasen & Daugherty 0426* (male), *0457* (female) (ASC); Olallie Ridge, 2004, *Mathiasen & Daugherty 0454* (female) (ASC), on *A. procera*, 2004, *Mathiasen & Daugherty 0455* (female) (ASC); Pat Saddle, 1997, *Mathiasen 97164* (male) (ASC), 2004, *Mathiasen & Daugherty 0453* (female) (ASC), on *A. procera*, 1997, *Mathiasen 97166* (male) (ASC); Lowell Mtn., 1997, *Mathiasen 97170* (male) (ASC), 2004, *Mathiasen & Daugherty 0424* (male), *0451* (female) (ASC), on *T. mertensiana*, 2004, *Mathiasen & Daugherty 0423* (male), *0452* (female) (ASC); Huckleberry Mtn., 2004, *Mathiasen & Daugherty 0448* (female) (ASC), 2005, *Mathiasen & Daugherty 0555* (male) (ASC), on *T. mertensiana*, 2004, *Mathiasen & Daugherty 0449* (female) (ASC); Blair Lake, 1997, *Mathiasen 97168* (male) (ASC), 2004, *Mathiasen & Daugherty 0422* (male), *0446* (female) (ASC), on *T. mertensiana*, 1997, *Mathiasen 97169* (male) (ASC), 2004, *Mathiasen & Daugherty 0421* (male), *0447* (female) (ASC); Holland Meadow, 2004, *Mathiasen & Daugherty 0450* (female) (ASC); Hemlock Butte, 2000, *Mathiasen 0041* (male) (ASC), 2004, *Mathiasen & Daugherty 0444* (female) (ASC), on *T. mertensiana*, 2000, *Mathiasen 0042* (male) (ASC), 2004, *Mathiasen & Daugherty 0445* (female) (ASC); Warner Mtn., 2000, *Mathiasen 0038* (male) (ASC), 2004, *Mathiasen & Daugherty 0442* (female) (ASC), on *T. mertensiana*, 2004, *Mathiasen & Daugherty 0443* (female) (ASC); Douglas Co., Staley Ridge, 2000, *Mathiasen 0039* (male) (ASC), 2004, *Mathiasen & Daugherty 0440* (female) (ASC); Snowbird Camp, 2004, *Mathiasen & Daugherty 0438* (female) (ASC), 2005, *Mathiasen & Daugherty 0553* (male) (ASC).

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New Species and a New Combination in *Astragalus* (Leguminosae) from China

Dietrich Podlech

Ludwig-Maximilians-University Munich, Department Biologie I–Systematic Botany, Menzinger Straße 67, D-80638, Munich, Germany. podlech@lrz.uni-muenchen.de

Lang-Ran Xu

Northwestern Institute of Botany, Academia Sinica, Yangling 712100, Shaanxi, People's Republic of China

Abstract. Forty-four new species of *Astragalus* L. (Leguminosae) are described here. They belong to the following sections: section *Brachycarpus* Borissova: *A. athranthus* Podlech & L. R. Xu, *A. brachysemia* Podlech & L. R. Xu, *A. despectus* Podlech & L. R. Xu; section *Caprini* DC.: *A. fukangensis* Podlech & L. R. Xu, *A. luculentus* Podlech & L. R. Xu, *A. psilosepalus* Podlech & L. R. Xu; section *Chlorostachys* Bunge: *A. brachytrichus* Podlech & L. R. Xu, *A. chengkangensis* Podlech & L. R. Xu, *A. zadaensis* Podlech & L. R. Xu; section *Cysticalyx* Bunge: *A. gongliuensis* Podlech & L. R. Xu; section *Dissitiflori* DC.: *A. laetabilis* Podlech & L. R. Xu; section *Erioceras* Bunge: *A. yangchangii* Podlech & L. R. Xu; section *Helmia* Bunge: *A. hoshanbaoensis* Podlech & L. R. Xu, *A. persimilis* Podlech & L. R. Xu; section *Hypsophilus* Bunge: *A. yechengensis* Podlech & L. R. Xu; section *Komaroviella* Gontscharow: *A. leptocladus* Podlech & L. R. Xu; section *Laguropsis* Bunge: *A. chamaephyton* Podlech & L. R. Xu; section *Ornithopodium* Bunge: *A. huochengensis* Podlech & L. R. Xu, *A. maiusculus* Podlech & L. R. Xu, *A. sadiensis* Podlech & L. R. Xu, *A. supralaevis* Podlech & L. R. Xu; section *Oroboidei* A. Gray: *A. gongshanensis* Podlech & L. R. Xu; section *Poliothrix* Bunge: *A. baxoiensis* Podlech & L. R. Xu, *A. jiazaensis* Podlech & L. R. Xu; section *Trachycercis*: *A. acceptus* Podlech & L. R. Xu, *A. brevivexillatus* Podlech & L. R. Xu, *A. filidens* Podlech & L. R. Xu, *A. glabritubus* Podlech & L. R. Xu, *A. levidensis* Podlech & L. R. Xu, *A. lustricola* Podlech & L. R. Xu, *A. lychnobius* Podlech & L. R. Xu, *A. macriculus* Podlech & L. R. Xu, *A. ningxiaensis* Podlech & L. R. Xu, *A. occultus* Podlech & L. R. Xu, *A. perbrevis* Podlech & L. R. Xu, *A. porphyreus* Podlech & L. R. Xu, *A. secretus* Podlech & L. R. Xu, *A. sinkiangensis* Podlech & L. R. Xu, *A. tesquorum* Podlech & L. R. Xu, *A. transecticola* Podlech & L. R. Xu, *A. trijugus* Podlech & L. R. Xu, *A. vescus* Podlech & L. R. Xu, *A. visibilis* Podlech & L. R. Xu; section *Uliginosi* A. Gray: *A. qitaiensis* Podlech & L. R. Xu. Furthermore, two taxa are raised in rank.

Key words: *Astragalus*, China, Leguminosae.

During a stay in China to see the rich *Astragalus* L. (Leguminosae) material in the largest herbaria, namely, Beijing (PE), Kunming (KUN), and Yangling (WUK), we identified a number of new species that were previously unnamed or wrongly named. They are described here. The flora of China is very rich in *Astragalus* species. In a forthcoming volume of *Flora of China*, 388 species, of which 210 are endemic in China, will be treated.

1. Astragalus sect. **Brachycarpus** Borissova, in Fl. URSS 12: 877. 1946. TYPE: *Astragalus melanostachys* Bentham (lectotype, designated by Podlech, 1990: 466).

1. Astragalus athranthus Podlech & L. R. Xu, sp. nov. TYPE: China. Qinghai: Chaidam [Qaidam] basin, Donjishan kou, 4020 m, 5 July 1959, *Qinghai-Gansu Team 578* (holotype, PE).

Differt ab *Astragalo densifloro* Karelin & Kirilov stipulis foliorum superiorum laxe albo-nigro-pilosis, imprimis margines apicemque versus (nec margine tantum albo-ciliatis), calyce 5–6 mm (nec 3–4 mm) longo, vexillo ca. 9 mm (nec 6–7 mm) longo, laminis alarum obovato-spathulatis, apicem truncatum versus valde dilatatis, 2 mm latis (nec anguste oblongis, 1.2 mm latis), ovariis glabris (nec pilosis).

Plants ca. 15 cm tall. *Caudex* with ± elongated, slender, branched stolons. *Stems* 3–10 cm long, slender, prostrate to ascending, loosely to densely covered with appressed, white hairs 0.3–0.5 mm long, at the nodes with some black hairs mixed in, the basal parts and the stolons glabrous. *Stipules* adnate to the petiole for 1–2 mm, those of lower leaves membranous, 3–4 mm long, triangular, shortly vaginate-connate behind the stem, glabrous or sparsely hairy, those of upper leaves greenish, narrowly triangular, 5–7 mm long, free from each other, loosely white and black hairy, especially toward the margins and the tip.

Leaves 3.5–5.5 cm long; petiole 1–1.5 cm long, like the rachis loosely covered with appressed to slightly ascending, tangled white hairs 0.3–0.5 mm long, sometimes with black hairs mixed in. *Leaflets* in 5 to 8 pairs, narrowly elliptic, 6–18 × 2–3.5 mm, obtuse to acute, on upper side glabrous, on underside loosely to densely covered with appressed to subappressed white hairs 0.3–0.6 mm long. *Peduncles* 4–7 cm long, rather densely hairy like the rachis, toward the raceme with increasing black hairs. *Racemes* ovoid, ca. 3 × 2 cm, densely many-flowered. *Bracts* whitish membranous, very narrowly triangular, ca. 4(–5) mm long, black hairy. *Pedicels* 1–1.5 mm long, black hairy. *Calyx* pale reddish brown, 5–6 mm long, campanulate, ± densely covered with slightly ascending black hairs 0.5–1 mm long, with some grayish hairs mixed in; teeth subulate, 2–3 mm long, hairy on inner side. *Petals* yellowish when dry. *Standard* ca. 9 mm long; limb ca. 4 mm wide, oblong-obovate, emarginate, subabruptly contracted into a claw ca. 3 mm long. *Wings* ca. 7 mm long; limbs obovate-spathulate, truncate, 4 × 2 mm; auricle ca. 0.5 mm long, claw ca. 3 mm long. *Keel* ca. 6 mm long; limbs obliquely elliptic-curved, with widely curved lower edge and slightly concave upper edge, subacute, ca. 3 × 1.8 mm; auricle minute, claw ca. 2.5 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* sessile, widely ovoid, glabrous. *Legumes* unknown.

Astragalus athranthus differs from *A. densiflorus* by stipules of upper leaves loosely black hairy, especially at the margins and toward tip (vs. only at the margins white ciliate); calyx 5–6 mm (vs. 3–4 mm); standard ca. 9 mm (vs. 6–7 mm); wing limbs obovate-spathulate, strongly dilated toward the truncate tip (vs. narrowly oblong, 1.2 mm wide); and ovary glabrous (vs. hairy).

Etymology. The species epithet is from the Latin "athranthus," meaning "with packed flowers."

2. Astragalus brachysemia Podlech & L. R. Xu, sp. nov. TYPE: China. NW Sichuan: Norgai, ca. 33°N, 103°E, 3420 m, 13 Aug. 1975, s. coll. *no. 10393* (holotype, PE).

Differt ab *Astragalo densifloro* Karelin & Kirilov caulibus 13–15 cm longis (nec 2–5(–10) cm longis), pilis 0.1–0.3 mm (nec 0.4–0.5 mm) longis obtectis, stipulis inter se liberis (nec inferioribus a tergo caulis breviter connatis), imprimis nigro-pilosis (nec margine tantum albo-ciliatis), rhachidibus saepissime albo-nigro-pilosis (nec mere albo-pilosis), ovariis glabris (nec pilosis).

Plants ca. 25 cm tall. *Stems* ca. 13–15 cm long, prostrate to ascending, rather densely covered with subappressed white hairs 0.1–0.3 mm long, soon glabrescent. *Stipules* greenish, narrowly triangular, 3.5–6 mm long, very shortly adnate to the petiole, otherwise free, sparsely to loosely predominantly black hairy. *Leaves* 4–7 cm long; petiole 0.5–1 cm long, like the rachis sulcate adaxially, loosely white or white and black hairy like the stem. *Leaflets* in 4 to 6 pairs, narrowly elliptic, 10–20 × 2–5 mm, subobtuse to obtuse, on upper side glabrous, on underside loosely covered with appressed white hairs 0.2–0.5 mm long. *Peduncles* 6–8 cm long, angular-sulcate, hairy like the stem, toward the raceme with increasing, more spreading black hairs. *Racemes* cylindric, ca. 5 cm long, rather densely to densely many-flowered. *Bracts* whitish membranous, linear to very narrowly triangular, 2–4 mm long, black hairy. *Pedicels* ca. 0.5 mm long, black hairy. *Calyx* ca. 4 mm long, campanulate, ± densely covered with ascending black hairs ca. 0.5 mm long; teeth subulate, 1.5–2 mm long, black hairy on inner side. *Petals* violet, in dry state very pale lilac. *Standard* ca. 6 mm long; limb obovate, ca. 3.5 mm wide, rounded, gradually narrowed at the base without distinct claw. *Wings* ca. 5 mm long; limbs narrowly oblong, slightly curved, rounded, ca. 3 × 1.2 mm; auricle ca. 0.4 mm long, claw ca. 2 mm long. *Keel* ca. 4 mm long; limbs obliquely obovate, upper part with nearly rectangularly curved lower edge and slightly curved upper edge, subacute, 2 × 1 mm; auricle minute, claw ca. 2 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* with a slender stipe ca. 0.5 mm long, subglobular, glabrous. *Legumes* unknown.

Astragalus brachysemia differs from *A. densiflorus* by stems 13–15 cm long, covered with hairs 0.1–0.3 mm (vs. 2–5(–10) cm, with hairs 0.4–0.5 mm); stipules free from each other, predominantly black hairy (vs. those of lower leaves shortly connate behind the stem, all only white ciliate at the margins); rachis mostly white and black hairy (vs. only white hairy); and ovary glabrous (vs. hairy).

Etymology. The specific epithet is from the Greek "brachysemia," meaning "short standard."

3. Astragalus despectus Podlech & L. R. Xu, sp. nov. TYPE: China. Xizang: near Shuang Hu, ca. 33°35′N, 86°58′E, 5100 m, 4 Aug. 1976, *K. J. Lang 9942* (holotype, PE; isotype, KUN).

Differt ab *Astragalo malcolmii* Hemsley & H. Pearson cui habitu similis, caule evoluto, 1–3.5 cm longo, internodio basali excepto appresse piloso (nec planta acaulescente ad subacaulescente, internodiis basalibus exceptis pilis ascendentibus ad patentibus obtectis), stipulis ca. 5 mm (nec 2.5–3 mm) longis, rachide appresse (nec patenter) piloso, foliolis supra glabris, subtus laxe appresse pilosis (nec supra sparse ad laxe, subtus laxe ad dense subpatenter pilosis),

pedunculis subappresse (nec subpatenter) pilosis, vexillo ca. 5.5 × 3.5 mm (nec 7–8 × 5–5.5 mm).

Plants small, 4–5 cm tall, subacaulescent to shortly caulescent. *Caudex* with slender, elongated, branched, subterranean stolons furnished with pale leafless stipules. *Stems* 1–3.5 cm long, lowest internodes glabrous, the next one internode densely covered with ascending hairs, the upper ones loosely covered with appressed white hairs 0.2–0.3 mm long, toward the nodes with few black hairs mixed in. *Stipules* greenish to whitish, ca. 5 mm long, ovate, very shortly adnate to the petiole, the lower ones and those of the leafless stolons highly vaginate-connate, the upper ones free from each other, sparsely white or black hairy, ciliate at the margins. *Leaves* 2–2.5 cm long; petiole up to 0.5 cm long, like the rachis loosely to rather densely covered with appressed white hairs 0.1–0.2 mm long, with black hairs mixed in. *Leaflets* in 5 to 8 pairs, narrowly elliptic, 3–7 × 1.5–3 mm, obtuse, upper side glabrous, on underside loosely covered with appressed white hairs 0.1–0.3 mm long. *Peduncles* subterminal, 1.5–2 cm long, loosely to rather densely covered with subappressed white hairs 0.1–0.2 mm long, with some longer, mostly black hairs up to 0.5 mm long mixed in. *Racemes* globular, 1–1.5 cm diam., densely ca. 20-flowered. *Bracts* whitish membranous, 1.5–3 mm long, narrowly triangular, sparsely black hairy. *Pedicels* very short, predominantly black hairy. *Calyx* campanulate, ca. 3 mm long, densely covered with ascending to spreading, tangled, predominantly black hairs 0.4–0.6 mm long; teeth narrowly triangular-linear, 1–1.5 mm long, on inner side black hairy. *Petals* mauve. *Standard* ca. 5.5 mm long; limb ca. 3.5 mm wide, suborbicular, slightly emarginate, narrowed at the base without distinct claw. *Wings* ca. 4 mm long; limbs obtriangular, widest below the widely truncate tip, ca. 2.5 × 1.8–2 mm; auricle ca. 0.5 mm long, claw 1.5–2 mm long. *Keel* ca. 4 mm long; limbs triangular, middle part with widely curved lower edge and ± straight upper edge, subobtuse, ca. 2 × 1.5 mm; auricle indistinct, claw ca. 1.5 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, globular, glabrous, 2-ovulate. *Legumes* unknown.

Astragalus despectus looks like *A. malcolmii* but differs by being shortly caulescent with stem 1–3.5 cm long, with exception of the lowermost internode covered with appressed hairs (vs. acaulescent to subacaulescent, with exception of the lowermost internodes covered with ascending to spreading hairs); stipules ca. 5 mm long (vs. 2.5–3 mm); rachis appressed (vs. spreading) hairy; leaflets on upper side glabrous, on underside loosely appressed hairy (vs. on upper side sparsely to loosely, on underside with more densely nearly spreading hairs); peduncles subappressed (vs. nearly spreading) hairy; and standard ca. 5.5 × 3.5 mm (vs. 7–8 × 5–5.5 mm).

Etymology. The specific epithet is from the Latin "despectus," meaning "overlooked."

Paratype. CHINA. **Xizang:** near Shuang Hu, ca. 86°58′E, 33°35′N, 5100 m, 4 Aug. 1976, *K. J. Lang 9833* (PE).

II. Astragalus sect. **Caprini** DC., Prodr. 2: 301. 1825. TYPE: *Astragalus caprinus* L.

1. Astragalus fukangensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: Fukang [ca. 50 km NNE Urumqi], 9 July 1998, *L. R. Xu 2013* (holotype, MSB; isotype, WUK).

Differt ab *Astragalo flexo* Fischer cui habitu similis planta glaberrima (nec pilis ad 2 mm longis instructa), racemis cum petiolo longissimis ad 35 cm longis, leguminibus stipite 3–4 mm (nec 6–8 mm) suffultis.

Plants ca. 40 cm tall, acaulescent, completely glabrous. *Caudex* simple, in upper part covered with remnants of old stipules. *Stipules* membranous, ca. 10 mm long, triangular, adnate to the petiole for ca. 2 mm. *Leaves* ca. 35 cm long; petiole 8–10 cm long, like the rachis 1.5–2.5 mm thick, rigid, slightly indurated. *Leaflets* in 7 to 8 pairs, remote, widely elliptic to suborbicular, rounded to retuse, 15–25 × 12–22 mm. *Peduncles* 15–18 cm long, up to 2.5 mm thick. *Racemes* as long as the peduncle, remotely up to 20-flowered. *Bracts* membranous, linear-acute, 8–10 mm long. *Flowers* unknown. *Legumes* with a stipe 3–4 mm long, ellipsoid, 17–18 mm long, 9–12 mm high, 9–10 mm wide, slightly keeled ventrally, widely rounded dorsally, with a triangular beak ca. 2 mm long, incompletely bilocular; valves thinly coriaceous, straw-colored.

Astragalus fukangensis looks similar to *A. flexus* but differs by being completely glabrous (vs. covered with hairs up to 2 mm long); by very long racemes with peduncle 15–18 cm long (vs. racemes rather short, with peduncle 5–12 cm); and by legumes with a stipe 3–4 mm long (vs. 6–8 mm).

2. Astragalus luculentus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: around Gongliu, 43°28′N, 82°13′E, 1500 m, 15 July 1990, *L. R. Xu 1514* (holotype, WUK).

Differt ab *Astragalo tschimganico* Popov stipulis albidis, 20–30 mm longis, anguste triangularibus longissime acuminatis, distincte longitudinaliter nervosis (nec hyalino-membranaceis, 11–15(–20) mm longis, breviter acuminatis, sine nervis distinctis), petiolo 8–11 cm (nec 3.5–7 cm) longis,

foliolis 11–15-jugis (nec 8–9-jugis), pedunculis 8–9 cm (nec 2–5 cm) longis, calycibus 12–13 mm (nec ad 20 mm) longis, dentibus 2–4 mm (nec 3–10 mm) longis, leguminibus subsessilibus (nec stipite 10–11(–20) mm longo suffultis).

Plants ca. 35 cm tall, completely glabrous. *Stems* stout, 3–4 mm diam., ca. 20 cm long, angular-sulcate, ascending to erect. *Stipules* whitish, 20–30 mm long (in sprouting branches, after grazing much smaller), narrowly triangular, very long-acuminate, distinctly longitudinally nerved, free from the petiole. *Leaves* 25–30 cm long; petioles 8–11 cm long. *Leaflets* in 11 to 15 pairs, ovate, 20–35 × 8–18 mm (in sprouting branches, after grazing much smaller), subacute to rounded, often minutely mucronulate. *Racemes* distributed along the whole stem, with a peduncle 8–9 cm long, loosely ca. 5- to 9-flowered. *Bracts* whitish, very narrowly triangular, 10–15 mm long. *Pedicels* 4–6 mm long. *Calyx* 12–13 mm long, tubular; teeth subulate, unequal, 2–4 mm long. *Petals* yellow. *Standard* ca. 25 mm long. *Keel* ca. 15 mm long. Other petal data missing. *Legumes* subsessile, oblong, straight, 18–25 mm long, 5–8 mm high and ca. 9 mm wide, rounded with prominent, thickened nerve ventrally, deeply and widely grooved dorsally, with a narrowly triangular beak 1–2 mm long, incompletely bilocular; valves coriaceous, pale brownish, dark brown suffused.

Astragalus luculentus differs from *A. tschimganicus* by whitish stipules 20–30 mm long, narrowly triangular, very long-acuminate, distinctly longitudinally nerved (vs. hyaline-membranous, 11–15(–20) mm, shortly acuminate, without distinct nerves); petiole 8–11 cm long (vs. 3.5–7 cm); leaflets in 11 to 15 pairs (vs. 8 to 9 pairs); peduncles 8–9 cm long (vs. 2–5 cm); calyx 12–13 mm long, with teeth 2–4 mm long (vs. up to 20 mm, with teeth 3–10 mm); and legumes subsessile (vs. with a stipe 10–11(–20) mm long).

Etymology. The specific epithet is from the Latin "luculentus," meaning full of light, bright, but also handsome.

Paratype. CHINA. **Xinjiang:** Gongliu, 1550 m, 4 May 1959, *A. R. Li 288* (KUN).

3. Astragalus psilosepalus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Habahe, ca. 48°02′N, 86°26′E, 1478 m, *Zhao Yang Chang et al. no. 2004-448* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo sewertzowii* Bunge stipulis a petiolo liberis (nec per 1–2 mm adnatis), calyce 11–13 mm (nec 17–20 mm) longo, dentibus adaxialibus triangularibus, 3–4 mm longis, abaxialibus anguste triangularibus, 4–5 mm longis (nec subulatis, 8–15 mm longis).

Plants 20–35 cm tall, acaulescent or shortly caulescent, glabrous or sparsely white hairy. *Caudex* up to 10 mm thick, scarcely divided, with short, thick branches. *Stems*, if present, up to 7 cm long. *Stipules* whitish membranous, 10–20 mm long, narrowly ovate, free from the petiole, the lower ones obtuse, the upper acute, glabrous. *Leaves* 12–35 cm long; petiole 4–8 cm long, at the base up to 2 mm thick, like the rachis finely striate-sulcate, glabrous or loosely covered with spreading hairs 1–2 mm long. *Leaflets* in 10 to 15 pairs, ovate, 8–30 × 5–22 mm, rounded to very shortly acuminate, glabrous or at the margins and on underside at the midvein sparsely covered with spreading hairs ca. 1 mm long. *Peduncles* 0.5–2 cm long. *Racemes* very loosely 5- to 7-flowered. *Bracts* whitish membranous, narrowly triangular, 5–12 mm long, glabrous or loosely hairy. *Pedicels* 3–7 mm long. *Calyx* 11–13 mm long, shortly tubular, obliquely cut at the mouth, glabrous or with few spreading hairs at the teeth; teeth unequal, the upper (adaxial) 2 triangular, 3–4 mm long, the lower (abaxial) 3 narrowly triangular, 4–5 mm long. *Petals* yellow or greenish yellow. *Standard* 24–25 mm long; limb 8–9 mm wide, oblong to elliptic, emarginate, gradually narrowed into the short, wide claw. *Wings* 20–22 mm long; limbs narrowly oblong, rounded, 10–12 × 3–3.5 mm; auricle ca. 1 mm long, claw ca. 10 mm long. *Keel* 17–18 mm long; limbs elliptic, with slightly curved lower edge and upper edge, acute, ca. 8 × 4 mm; auricle triangular, acute, 0.5–0.8 mm long, claw ca. 10 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* with a stipe 1–1.5 mm long, hairy. *Legumes* ellipsoid, ca. 20 mm long and 10 mm high.

Astragalus psilosepalus differs from *A. sewertzowii* by stipules free from the petiole (vs. adnate to it for 1–2 mm); and calyx 11–13 mm long with adaxial teeth triangular, 3–4 mm long, abaxial teeth narrowly triangular, 4–5 mm long (vs. 17–20 mm with teeth subulate, 8–15 mm).

Etymology. The specific epithet is from the Greek "psilo," meaning "glabrous," and the Latin "sepalus," meaning "sepals"; therefore, "with glabrous calyx."

Paratypes. CHINA. **Xinjiang:** Gongliu, 82°13′E, 43°28′N, 1259 m, 19 May 1904, *C. Y. Chang et al. 2004-283* (WUK); Gongliu, Merhe, Qiaxi, 1500 m, 15 July 1989, *L. R. Xu 1514* (PE); between Burqin and Altai, May 2004, *C. Y. Chang et al. 2004-259* (WUK).

III. Astragalus sect. **Chlorostachys** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 27. 1868. TYPE: *Astragalus chlorostachys* Lindley.

1. Astragalus brachytrichus Podlech & L. R. Xu, sp. nov. TYPE: China. Xizang: Langxian, 3100 m, 4 Aug. 1982, *C. C. Ni et al. 2253* (holotype, PE).

Differt ab *Astragalo lucido* H. T. Tsai & T. T. Yu stipulis ca. 5 mm, in ramis lateralibus 2–3 mm longis (nec 7–16(–25) mm longis), foliolis 4–7 × 2–3.5 mm (nec 6–15 × 2.5–7 mm), bracteis 1–3 mm longis, anguste triangularibus ad linearibus (nec 4–5 mm longis et ca. 2 mm latis, spathulatis ad anguste ellipticis), vexillo ca. 9 mm (nec 11 mm) longo.

Plants at least 35 cm tall (basal parts missing). *Stems* branched, erect, slender, 1.5 mm thick, finely angular-sulcate, glabrous, those of side branches sparsely covered with subappressed white hairs 0.15–0.3 mm long. *Stipules* membranous to greenish, narrowly triangular, ca. 5 mm long, in side branches 2–3 mm long, free, at the margins and tip sparsely white and black hairy. *Leaves* 3–7 cm long; petiole 0.5–1.5 cm long, like the rachis very slender, sparsely to loosely white hairy, with some black hairs mixed in. *Leaflets* in 8 to 15 pairs, elliptic, 4–7 × 2–3.5 mm, truncate to retuse, on upper side glabrous, on underside sparsely appressed hairy at the margin and at the midrib. *Peduncles* 3–4.5 cm long, angular-sulcate, sparsely white hairy like the rachis, with few black hairs mixed in. *Racemes* 2–3 cm long, rather densely 12- to 15-flowered. *Bracts* whitish membranous, narrowly triangular to linear-acute, 1–3 mm long, sparsely hairy like the stipules. *Pedicels* 1–2 mm long, loosely black hairy. *Calyx* ca. 4 mm long, obliquely campanulate, glabrous or with scattered hairs only, between and at the teeth sparsely black ciliate; teeth unequal, narrowly triangular, the 3 abaxial ca. 2 mm long, the 2 adaxial ca. 1 mm long, on inner side glabrous or sparsely black hairy. *Petals* greenish yellow. *Standard* ca. 9 mm long; limb obovate, ca. 5 mm wide, emarginate, gradually narrowed into the short cuneate claw. *Wings* ca. 8 mm long; limbs narrowly oblong, rounded, 4 × 1 mm; auricle ca. 0.3 mm long, claw ca. 4 mm long. *Keel* ca. 8 mm long; limbs obliquely elliptic, obtuse, 4 × 2 mm; auricle triangular, 0.6–1 mm long, claw 4 mm long. *Stamen tube* truncate at the mouth. *Ovary* with a stipe ca. 2 mm long, glabrous. *Legumes* (unripe) with a stipe 3–4 mm long, obliquely ellipsoid, somewhat curved, ca. 10–12 mm long, incompletely bilocular (septum to 3/4 of the fruit's height); valves thinly membranous, pale brownish, glabrous.

Astragalus brachytrichus differs from *A. lucidus* by stipules ca. 5 mm long, in side branches 2–3 mm long (vs. 7–16(–25) mm); leaflets 4–7 × 2–3.5 mm (vs. 6–15 × 2.5–7 mm); bracts 1–3 mm long, narrowly triangular to linear (vs. 4–5 × ca. 2 mm, spathulate to narrowly elliptic); and standard ca. 9 mm long (vs. 11 mm).

Etymology. The specific epithet derives from the Greek, and it means "with short hairs."

2. Astragalus chengkangensis Podlech & L. R. Xu, sp. nov. TYPE: China. Yunnan: Chengkang [Zhenkang], snow range, 2900 m, 2 Aug. 1938, *T. T. Yu 17255* (holotype, PE).

Differt ab *Astragalo dumetorum* Handel-Mazzetti caudice simplice, caule singulare irramoso (nec caudice ramoso, caulibus nonnullis, saepe ramis lateralibus non-floriferis evolutis), foliolis 8–11-jugis, 15–30 × 5–13 mm, supra saepissime sparse pilosis (nec 12–16-jugis, 5–18 × 3–8 mm, supra glabris), bracteis persistentibus, laxe pilosis (nec mox caducis, glabris), bracteolis evolutis, 2–3 mm longis, persistentibus (nec interdum tantum evolutis, 0.4–1 mm longis, mox caducis), vexillo 16–17 mm (nec 10–11 mm) longo.

Plant ca. 110 cm tall. *Caudex* slender, unbranched. *Stems* singular, ca. 100 cm long, ca. 4 mm diam., hollow, erect, striate, glabrous. *Stipules* green, narrowly triangular to ovate-acuminate, 10–15 mm long, obliquely inserted at the stem, free, white hairy at the margins and tip. *Leaves* 10–17 cm long; petiole 2–2.5 cm long, like the rachis sulcate adaxially, sparsely to rather loosely covered with subappressed to ascending, tangled white and black hairs up to 1 mm long. *Leaflets* in 8 to 11 pairs, narrowly elliptic, 15–30 × 5–13 mm, rounded, minutely mucronulate, on upper side mostly sparsely appressed hairy, on underside loosely, at the margins more densely covered with white hairs 0.2–0.5 mm long. *Peduncles* several in each stem, in the axils of the upper leaves, 8–12 cm long, hairy like the rachis. *Racemes* rather densely 12- to 22-flowered, elongating after anthesis. *Bracts* greenish, narrowly ovate, long-acuminate, 7–11 mm long, loosely covered with tangled, white and black hairs up to 1 mm long, ± persistent. *Pedicels* 3–4 mm long, with short blackish hairs, erect, bent at the insertion of the calyx, flowers and fruits therefore spreading. *Bracteoles* 2–3 mm long, at the base of calyx, persistent. *Calyx* shortly tubular, ca. 8 mm long, obliquely gibbous at the mouth, rather densely covered with subappressed to ascending, predominantly black hairs 0.2–0.8 mm long; teeth narrowly triangular, ca. 2 mm long, black hairy on inner side. *Petals* yellow. *Standard* 16–17 mm long; limb obovate, ca. 7 mm wide, emarginate, slightly constricted near the base, subabruptly angularly passing into the claw ca. 5 mm long. *Wings* ca. 15 mm long; limbs narrowly oblong, slightly narrowed toward the obtuse tip, ca. 7 × 2.5 mm; auricle ca. 2 mm long, claw 8 mm long. *Keel* ca. 15 mm long; limbs obliquely obovate, elliptic, with widely curved lower edge and slightly concave upper edge, obtuse, 6 × 3 mm;

auricle widely triangular, ca. 1 mm long, claw ca. 10 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* with a stipe ca. 5 mm long, linear, glabrous. *Legumes* unknown.

Astragalus chengkangensis differs from *A. dumetorum* by its simple, non-branched stem (vs. stems several, mostly with non-flowering side-branches); leaflets in 8 to 11 pairs, 15–30 × 5–13 mm, on upper side mostly sparsely hairy (vs. in 12 to 16 pairs, 5–18 × 3–8 mm, on upper side glabrous); bracts persistent, loosely hairy (vs. soon falling, glabrous); bracteoles present, 2–3 mm long, persistent (vs. only rarely present, 0.4–1 mm long, soon falling); standard 16–17 mm long (vs. 10–11 mm).

This species is placed in section *Chlorostachys* provisionally because it is not clear if the fruit is unilocular or bilocular. In habit and most characters, it resembles *Astragalus dumetorum* and not any species of section *Cenantrum* with glabrous ovary.

3. Astragalus zadaensis Podlech & L. R. Xu, sp. nov. TYPE: China. SW Xizang: near Zada, 3500 m, 28 June 1976, *Qinghai-Tibetan Exped. 76-8083* (holotype, KUN).

Astragalo mongholico Bunge e sect. *Cenantrum* Bunge similis, sed differt in partibus vegetativis pilis 0.2–0.5 mm (nec 1–1.5(–2) mm) longis instructus, rhachidibus glabris vel subglabris (nec sparse ad laxe appresse ad patenter pilosis), foliolis apice acuminato-mucronulatis (nec rotundatis ad retusis vel leviter emarginatis), bracteis cito caducis, sub anthesin jam delapsis (nec persistentibus), leguminibus ± anguste ellipticis (nec a latere visis oblique ellipticis ad subsemicircularibus), bilocularibus (nec unilocularibus).

Plants more than 55 cm tall, covered in vegetative parts with appressed white hairs 0.2–0.5 mm long. *Stems* erect, at the base ca. 4 mm diam., finely angular-sulcate, glabrous. *Stipules* of lower leaves unknown, of upper leaves ca. 5 mm long, glabrous very sparsely white and black hairy, soon falling. *Leaves* 6–15 cm long, nearly sessile; rachis glabrous or with scattered hairs only. *Leaflets* in 6 to 8 pairs, elliptic, acuminate-mucronulate, 10–20 × 5–12 mm, on both sides glabrous or with scattered hairs only. *Peduncles* 7–10 cm long, with scattered white and black hairs. *Racemes* 5–7 cm long, loosely 10- to 12-flowered; axis with scattered white and black hairs. *Bracts* whitish membranous, narrowly triangular to linear, ca. 2 mm long, white and black hairy. *Pedicels* 1–2.5 mm long, sparsely black hairy. *Bracteoles* whitish, linear, 1–2 mm long, at the pedicel just below the calyx. *Calyx* campanulate-tubular, 9–11 mm long, obliquely cut at the mouth, sparsely covered with ascending to spreading black hairs 0.3–0.5 mm long; teeth subulate, 4–5 mm long. *Petals* pale lilac. *Standard* ca. 18 mm long; limb ca. 8 mm wide. *Wings* ca. 17 mm long. *Keel* ca. 17 mm long; limbs ± triangular, with rectangularly curved lower edge and slightly concave upper edge, obtuse, ca. 7 × 4 mm; auricle ca. 1 mm long, claw ca. 10 mm long. *Stamen tube* strongly obliquely cut at the mouth. *Ovary* with a stipe 4–7 mm long, glabrous. *Legumes* with a slender stipe 8–10 mm long, narrowly ellipsoid, 20–25 mm long, ca. 6 mm high, keeled ventrally, narrowly rounded dorsally, shortly acuminate, bilocular; valves membranous, dull straw-colored, glabrous.

Astragalus zadaensis is similar to *A. mongholicus* (sect. *Cenantrum*) but differs by hairs in vegetative parts 0.2–0.5 mm long (vs. 1–1.5(–2) mm); rachis glabrous to subglabrous (vs. sparsely to loosely spreadingly hairy); leaflets acuminate-mucronulate (vs. rounded to retuse or slightly emarginate); bracts very soon falling, at flowering time mostly fallen away (vs. bracts persistent); and legumes ± narrowly elliptic, bilocular (vs. obliquely elliptic to semicircular, unilocular).

IV. Astragalus sect. **Cysticalyx** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 135. 1868. TYPE: *Astragalus cysticalyx* Ledebour.

1. Astragalus gongliuensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Gongliu, ca. 43°28′N, 82°13′E, 1100 m, 29 May 1985, *Z. Hai 85-112* (holotype, WUK).

Differt ab *Astragalo tyttocarpo* Gontscharow stipulis omnibus inter se liberis, mere albo-pilosis (nec inferioribus a tergo caulis connatis, praecipue nigro-pilosis), foliolis 10–20 × 1–1.5 mm (nec 12–35 × 3–4 mm), supa sparse ad laxe, subtus dense pilosis (nec supra sparsissime et remote, subtus sparse pilosis), racemis 3–4 cm longis (nec 6–10 cm longis), bracteis praecipue albo-pilosis (nec nigro-pilosis), calyce fructifero ca. 14 mm (nec 8–11 mm) longo.

Plants subshrubby, 25–45 cm tall. *Caudex* divided, covered with blackish brown bark. *Stems* branched, the older parts ligneous, covered with blackish bark, 3–4 cm long; parts of the current year up to 20 cm long, very densely covered with medifixed, appressed white hairs ca. 1 mm long, toward the nodes with scattered black hairs mixed in. *Stipules* 4–6 mm long, adnate to the petiole for 1–2 mm, otherwise free from each other, densely appressed hairy like the stem. *Leaves* 4–8 cm long, subsessile; rachis sulcate adaxially, densely white hairy like the stem. *Leaflets* in 5 to 7 pairs, linear, 10–20 × 1–1.5 mm, acute, on upper side sparsely to loosely, on underside densely covered with medifixed hairs 1–1.5 mm long. *Peduncles* 10–13 cm long, densely hairy like the stem, toward the raceme with some black hairs mixed in, slightly glabrescent with age. *Racemes* ca. 3–4 cm

long, ca. 3 cm diam., densely ca. 12-flowered. *Bracts* whitish membranous, 3–4 mm long, narrowly triangular, covered with subbasifixed to basifixed, spreading white hairs 1–1.5 mm long, with shorter black hairs mixed in. Calyx at anthesis tubular, soon ovoid-inflated, ca. 14 mm long, loosely covered with strongly to extremely asymmetrically bifurcate, ascending to spreading white hairs 1–2 mm long and with more symmetrically bifurcate, subappressed black hairs 0.5–1 mm long. *Petals* yellow. *Standard* ca. 19 mm long; limb ca. 4 mm wide, narrowly oblong, emarginate, gradually narrowed into a claw ca. 4 mm long. *Wings* ca. 17 mm long; limbs narrowly oblong, obtuse, ca. 6 × 2 mm; auricle ca. 0.8 mm long, claw 11 mm long. *Keel* ca. 16 mm long; limbs obliquely elliptic, slightly curved, with slightly, widely curved lower edge and slightly concave upper edge, obtuse, 5 × 2 mm; auricle minute, claw 11 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely covered with subbasifixed, ascending white hairs at least 1.5 mm long. *Legumes* unknown.

Astragalus gongliuensis differs from *A. tyttocarpus* by all stipules free from each other and white hairy (vs. the lower ones behind the stem connate, predominantly black hairy); leaflets 10–20 × 1–1.5 mm, on upper side sparsely to loosely, on underside densely hairy (vs. 12–35 × 3–4 mm, on upper side with scattered hairs only, on underside sparsely hairy); racemes 3–4 cm long (vs. 6–10 cm); bracts predominantly white hairy (vs. black hairy); and fruiting calyx ca. 14 mm long (vs. 8–11 mm).

V. Astragalus sect. **Cytisodes** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 127. 1868. TYPE: *Astragalus cytisodes* Bunge.

1. Astragalus yanerwoensis (S. B. Ho) Podlech & L. R. Xu, nom. et stat. nov. Basionym: *Astragalus pavlovianus* Gamajunova var. *longirostris* S. B. Ho, Bull. Bot. Res. North-East. Forest. Inst. 3(1): 67. 1983. TYPE: China. Xinjiang: Ürümqi, Yanerwo, 17 May 1962, *Inst. Bio.-Ped.-Psamm. Xinjiang 3510* (holotype, XJBI; isotype, WUK).

This species differs from *Astragalus pavlovianus* by several characters: stipules 3–7 mm long, predominantly white hairy (vs. 1.8–2.5 mm, black hairy); leaflets narrowly elliptic to elliptic, 7–15 × 3–5 mm (vs. narrowly elliptic to nearly linear, 4–17 × 1.5–3 mm); peduncles 1.5–4 cm long (vs. 5–15 cm); bracts 4–6 mm long (vs. 2 mm); calyx ca. 15 mm long (vs. 11–13 mm); standard ca. 24 mm long (vs. 17–18 mm); and legumes without beak 15–20 mm long, with a beak 6–10 mm long (vs. 35–50(–65) mm, with a beak ca. 6 mm).

VI. Astragalus sect. **Dissitiflori** DC., Prodr. 2: 284. 1825. TYPE: *Astragalus virgatus* Pallas (lectotype, designated by Podlech, 1990: 473).

1. Astragalus laetabilis Podlech & L. R. Xu, sp. nov. TYPE: China. Xizang: Zada, 2 July 1976, *Qinghai-Tibetan Complex Exped. 76-8141* (holotype, KUN).

Differt ab *Astragalo compresso* Ledebour caulibus laxe (nec densissime) pilosis, pilis nigris immixtis (nec mere albopilosis), foliolis filiformibus 0.3–0.5 mm (nec 1–1.5 mm) latis, petalis flavis (nec lilacino-purpureis), leguminibus praecipue nigro-pilosis (nec praecipue albo-pilosis).

Plants ca. 30 cm tall. *Caudex* with a pluricipital root crown, branched, like the older parts of stems covered with blackish bark. *Stems* several, ligneous old parts 2–3 cm long; parts of the current year up to 18 cm long, loosely covered with medifixed, appressed white hairs 0.4–0.5 mm long, with some black hairs mixed in. *Stipules* greenish, 1.5–3 mm long, triangular-acuminate to narrowly triangular, very shortly adnate to the petiole, hairy like the stem. *Leaves* 2–4.5 cm long; petiole 0.8–2 cm long, very slender, with the rachis loosely to rather densely hairy like the stem. *Leaflets* in 2 to 4 pairs, filiform, (4–)8–20 × 0.3–0.5 mm, acuminate, on both sides loosely covered with medifixed, appressed hairs 0.5–1 mm long. *Peduncles* 6–11 cm long, hairy like the stem. *Racemes* 2.5–4 cm long, 3- to 7-flowered. *Bracts* membranous, 1.5–2 mm long, narrowly triangular, predominantly black hairy. *Pedicels* ca. 2 mm long, black hairy. *Calyx* 11–12 mm long, tubular, slightly gibbous at the base, obliquely cut at the mouth, rather densely covered with ± medifixed, appressed white and black hairs 0.5–1 mm long; teeth subulate, 2–3 mm long, densely white hairy on inner side. *Petals* yellow. *Standard* ca. 20 mm long; limb 7–8 mm wide, obovate, emarginate, in the middle constricted, gradually narrowed into the short claw. *Wings* ca. 18 mm long; limbs narrowly oblong, obtuse, ca. 7.5 × 2.5 mm; auricle ca. 0.5 mm long, claw ca. 10 mm long. *Keel* ca. 15 mm long; limbs obliquely obovate, with widely curved lower edge and ± straight upper edge, subobtuse, ca. 5 × 2.5 mm; auricle minute, claw 10 mm long. *Stamen tube* truncate at the mouth. *Ovary* substipitate, linear, white and black hairy; style sparsely hairy at the base. *Legumes* (not fully ripe) linear, straight, 30–35 mm long, ca. 2 mm wide, keeled ventrally, narrowly grooved dorsally, shortly acuminate, bilocular; valves thinly coriaceous, straw-colored, densely covered with ± medifixed, appressed, predominantly black hairs 0.3–0.5 mm long.

Astragalus laetabilis differs from *A. compressus* by stems loosely covered with white hairs, with black

hairs mixed in (vs. very densely only white hairy); leaflets filiform 0.3–0.5 mm wide (vs. 1–1.5 mm wide); petals yellow (vs. lilac to purple); and legumes predominantly black hairy (vs. predominantly white hairy).

Etymology. The specific epithet is from the Latin "laetabilis," meaning "pleasant."

VII. Astragalus sect. **Erioceras** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 109. 1868. TYPE: *Astragalus erioceras* Fischer & C. A. Meyer.

1. Astragalus yangchangii Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang, Toli, ca. 45°56′N, 83°37′E, 800 m, 26 June 2004, *C. Y. Chang et al. 2004-368* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo pilutschensi* N. Ulziykhutag plantis acaulescentibus (nec caule breve evoluto), stipulis 1–2 mm longis, a petiolo liberis (nec 3–9 mm longis, petiolo adnatis), rhachidibus pilis ± medifixis ad 1 mm longis obtectis (nec pilis medifixis ad 1 mm longis et insuper pilis arcte asymmetrice bifurcatis ad 2 mm longis obtectis), foliolis 3–7-jugis (nec 9–16-jugis), bracteis 3–4 mm (nec 5–9 mm) longis, calycibus 11–12 mm (nec 12–15 mm) longis, leguminibus (20–)30–40 mm (nec 12–15 mm) longis.

Plants 8–12 cm tall, acaulescent. *Stipules* whitish membranous to slightly greenish, 1–2 mm long, triangular, free from the petiole, densely covered with ± medifixed, appressed, tangled white hairs ca. 1 mm long, at the margins also with basifixed hairs. *Leaves* 4–9 cm long; petiole 2–4 cm long, like the rachis densely covered with partly flexuose, tangled, ascending to spreading, ± medifixed white hairs 0.5–1 mm long. *Leaflets* in 3 to 7 pairs, elliptic, 5–10 × 3–5 mm, acute to rounded, on upper side loosely to rather densely, on underside densely covered with symmetrically to asymmetrically bifurcate, flexuose, tangled, ascending to spreading white hairs ca. 1 mm long. *Peduncles* 3–8 cm long, white hairy like the rachis, just below the raceme with some black hairs mixed in. *Racemes* (in fruit) rather densely 2- to 6-flowered; axis short white hairy with some black hairs mixed in. *Bracts* membranous, (2–)3–4 mm long, narrowly triangular, with strongly asymmetrically bifurcate, predominantly black hairs. *Pedicels* 1–2 mm long, white and black hairy. *Calyx* 11–12 mm long, tubular, obliquely cut at the mouth, rather densely villous, with ± symmetrically to extremely asymmetrically bifurcate, flexuose, tangled, ascending to spreading white hairs 0.5–1 mm long and, especially at the dorsal (lower) side and the teeth with shorter black hairs; teeth subulate, 2–3 mm long, white hairy on inner side. *Petals* unknown. *Legumes* sessile, linear, ± erect, straight or slightly curved, (20–)30–40 mm long, 2.5–3.5 mm high and wide, obtusely keeled ventrally, shallowly grooved dorsally, acuminate into a beak 1–2 mm long, bilocular; valves densely covered with symmetrically to asymmetrically bifurcate, ± appressed white hairs ca. 0.5–0.6 mm long and with extremely asymmetrically bifurcate, ascending to spreading hairs ca. 1 mm long.

Astragalus yangchangii differs from *A. pilutschensis* by being acaulescent (vs. shortly caulescent); stipules 1–2 mm long, free from the petiole (vs. 3–9 mm, adnate to the petiole); rachis covered with ± medifixed hairs up to 1 mm long (vs. beside the medifixed hairs with strongly asymmetrically bifurcate hairs up to 2 mm long); leaflets in 3 to 7 pairs (vs. 9 to 16 pairs); bracts 3–4 mm long (vs. 5–9 mm); calyx 11–12 mm long (vs. 12–15 mm); and legumes (20–)30–40 mm long (vs. 12–15 mm).

Etymology. Astragalus yangchangii is named in honor of Zhao-Yang Chang, Director of the Herbarium of Northwestern Institute of Botany, Yangling, Shaanxi Province (WUK).

VIII. Astragalus sect. **Helmia** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 111. 1868. TYPE: *Astragalus helmii* Fischer.

1. Astragalus hoshanbaoensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Tash Kurghan [Taxkorgan], 3700–3800 m, 3 July 1987, *Qinghai-Xizang Exped. 87-389* (holotype, PE).

Differt ab *Astragalo heptapotamico* Sumnevicz foliis 0.5–1 cm (nec ad 4(–7) cm) longis, foliolis unijugis, pilis 0.5–0.8 mm obtectis (nec 2–5-jugis, pilis 1–1.2 mm longis), calyce 6–7 mm longo dentibus ca. 1 mm (nec 8–10(–12) mm, dentibus 1.5–3.5 mm), vexillo 13–14 mm (nec 17–22(–25) mm) longo.

Plants 2–3 cm tall, acaulescent or nearly so, densely caespitose, forming compact mats, appressed white. *Caudex* with a pluricipital root crown. *Stems*, if present, up to 1 cm long, very densely covered with medifixed hairs 0.5–0.6 mm long. *Stipules* whitish hyaline, 2–3 mm long, connate up to the top, adnate to the petiole for ca. 1 mm, the lower ones glabrous or ciliate only at the margins, the uppermost ones loosely hairy like the stem, at the margins with asymmetrically bifurcate to subbasifixed hairs. *Leaves* 0.5–1 cm long, petiole 0.3–0.6 cm long, like the rachis grooved adaxially, densely hairy like the stem. *Leaflets* in 1 pair, close together, narrowly obovate, 3–5 × 1–2 mm, obtuse to acute, flat or boot-shaped to folded, on both sides densely covered with appressed, medifixed hairs 0.5–0.8 mm long. *Peduncles* 0.3–3 cm long, densely hairy like the stem, below the

rachis with some black hairs mixed in. *Racemes* 2- to 8-flowered, subsessile or with a peduncle up to 1 cm long, densely white hairy like the stem. *Bracts* whitish membranous, ovate to narrowly triangular, 1.5–3 mm long, white hairy, sometimes with black hairs mixed in, at the margins with subbasifixed hairs and minute subsessile glands. *Pedicels* ca. 1 mm long, white and black hairy. *Calyx* 6–7 mm long, tubular, slightly obliquely cut at the mouth, densely covered with medifixed, appressed white and black hairs 0.3–0.8 mm long; teeth narrowly triangular to subulate, ca. 1 mm long, densely white hairy on inner side. *Petals* pale purplish with darker keel. *Standard* 13–14 mm long; limb obovate, ca. 5 mm wide, emarginate, gradually narrowed at the base. *Wings* 12–13 mm long; limbs narrowly oblong, obtuse, ca. 7 × 1.5 mm; auricle short, claw 5–6 mm long. *Keel* ca. 11 mm long; limbs ca. 4 × 1.5 mm; auricle indistinct, claw ca. 7 mm long. *Stamen tube* truncate at the mouth. *Ovary* with a stipe ca. 1 mm long, narrowly ellipsoid, white hairy; style glabrous. *Legumes* unknown.

Astragalus hoshanbaoensis differs from *A. heptapotamicus* by leaves 0.5–1 cm long (vs. 4(–7) cm); leaflets in 1 pair, covered with hairs 0.5–0.8 mm long (vs. in 2 to 5 pairs, with hairs 1–1.2 mm); calyx 6–7 mm long, with teeth ca. 1 mm (vs. 8–10(–12) mm, with teeth 1.5–3.5 mm); and standard 13–14 mm long (vs. 17–22(–25) mm).

Etymology. *Astragalus hoshanbaoensis* is named in honor of Shan-bao Ho, who has contributed greatly to our knowledge of *Astragalus* in China.

Paratype. CHINA. **Xinjiang:** near Tash Kurghan [Taxkorgan], 12 June 1974, *Xinjiang expedition of NW Biological Institute 3107* (PE).

Astragalus persimilis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Wenquan, ca. 44°58′N, 81°06′E, 22 May 2004, *Zhao Yang Chang et al. 2004-307* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo chomutowii* B. Fedtschenko stipulis 1–2 mm (nec 3–5 mm) longis, foliolis 2–5-jugis (nec 1–3-jugis), bracteis ca. 1 mm (nec 2.5–4 mm) longis, dentibus calycis ca. 1 mm (nec 2–2.5 mm) longis, leguminibus (immaturis) ca. 15 mm longis, linearibus, appresse pilosis (nec 6–10 mm longis, oblongis, villosis).

Plants ca. 5 cm tall, acaulescent or nearly so, covered in vegetative parts with appressed, ± medifixed, merely white hairs. *Caudex* with a pluricipital root crown, with flowering and non-flowering rosettes. *Stems*, if present, up to 1 cm long, very densely covered with hairs ca. 0.5 mm long. *Stipules* whitish hyaline, 1–2 mm long, triangular-ovate, nearly free from the petiole, behind the stem connate shortly or up to the middle, loosely to rather densely hairy, at the margins also with basifixed hairs. *Leaves* 1.5–3 cm long; petiole 0.5–1.2 cm long, with the rachis hairy like the stem. *Leaflets* in 2 to 5 pairs, narrowly elliptic, acute, 2–6 × 1–1.5 mm, on both sides very densely covered with hairs ca. 1 mm long. *Peduncles* 2–3 cm long, densely hairy like the leaflets. *Racemes* short, rather densely 6- to 8-flowered. *Bracts* whitish membranous, ovate, ca. 1 mm long, white and black hairy. *Pedicels* ca. 1 mm long, black hairy. *Calyx* tubular, 7–8 mm long, obliquely cut at the mouth, rather densely covered with ± medifixed, subappressed, flexuose black hairs 0.5–1 mm long, with some longer, ascending, white and black hairs mixed in; teeth narrowly triangular, ca. 1 mm long, loosely hairy on inner side. *Petals* violet. *Standard* ca. 17 mm long; limb elliptic, ca. 6 mm wide, emarginate, gradually narrowed at the base. *Wings* ca. 14 mm long; limbs narrowly oblong, obtuse, 6.5 × 1.5 mm; auricle ca. 1 mm long, claw ca. 8 mm long. *Keel* ca. 13 mm long; limbs oblong-curved, with widely curved lower edge and slightly concave upper edge, subacute, 5 × 2 mm; auricle 0.5 mm long, claw 8 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, linear, densely appressed white hairy; style glabrous. *Legumes* (immature) sessile, linear, pendulous, distinctly falcate, ca. 15 mm long, acuminate; valves densely covered with symmetrically to strongly asymmetrically bifurcate, appressed white hairs 0.5–1 mm long.

Astragalus persimilis differs from *A. chomutowii* by stipules 1–2 mm long (vs. 3–5 mm); leaflets in 2 to 5 pairs (vs. in 1 to 3 pairs); bracts ca. 1 mm long (vs. 2.5–4 mm); calyx teeth ca. 1 mm long (vs. 2–2.5 mm); and legumes (unripe) ca. 15 mm long, linear, appressed hairy (vs. 6–10 mm long, oblong, villous).

Etymology. The specific epithet is from the Latin "persimilis," meaning "very similar," because the species is similar to other species of the section.

IX. Astragalus sect. **Hypsophilus** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 136. 1868. TYPE: *Astragalus nivalis* Karelin & Kirilov.

1. Astragalus yechengensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Yecheng, ca. 37°53′N, 77°22′E, 3100 m, 17 Aug. 1987, *Qinghai-Xizang Team 1126* (holotype, PE).

Differt ab *Astragalo kukunorico* N. Ulziykhutag planta 25–35 cm (nec 12–20 cm) alta, pedunculis 5–18 cm (nec 1–3 cm) longis, sparsissime ad sparse (nec densiuscule) pilosis, calyce pilis nigris 0.4–1.2 mm et albis ad 1.5 mm longis (nec

pilis nigris 0.3–0.5 mm longis et albis paulum longioribus) obtecto, ovariis stipite 1.5–2 mm longo suffultis, albo-nigro-pilosis (nec subsessilibus, mere albo-pilosis).

Plants 25–35 cm tall. *Caudex* with a pluricipital root crown and short subterranean branches. *Stems* several, densely covered with medifixed, appressed white hairs 0.3–0.6 mm long, with some black hairs mixed in, especially toward the nodes. *Stipules* membranous, 3–4 mm long, free from the petiole, connate behind the stem high up, loosely white and black hairy, partly glabrescent with age. *Leaves* 3–7 cm long; petiole 0.4–1.5 cm long, with the rachis sulcate adaxially, hairy like the stem. *Leaflets* in 5 to 8 pairs, elliptic, 4–7 × 1.5–3 mm, obtuse and mostly very minutely mucronulate, on upper side glabrous, on underside sparsely to loosely covered with appressed white hairs 0.4–0.8 mm long. *Peduncles* 5–18 cm long, very sparsely to sparsely hairy like the stem. *Racemes* ca. 3 cm long, densely ca. 8- to 10-flowered; axis loosely covered with symmetrically to asymmetrically bifurcate, subappressed black hairs, with few basifixed white hairs mixed in. *Bracts* whitish membranous, narrowly triangular, 3–4 mm long, with strongly asymmetrically bifurcate to basifixed white and black hairs. *Pedicels* ca. 1 mm long, predominantly black hairy. *Calyx* at anthesis narrowly ellipsoid, ca. 11 mm long, loosely covered with subappressed, symmetrically to strongly asymmetrically bifurcate, flexuose black hairs 0.4–1.2 mm long and with fewer strongly asymmetrically bifurcate to basifixed white hairs 1–1.5 mm long; teeth triangular, ca. 1 mm long, on inner side densely white hairy. *Petals* probably white with violet-tipped keel or pale violet. *Standard* 19–20 mm long; limb ca. 7 mm wide, narrowly obovate, retuse, gradually narrowed into the short claw. *Wings* 16–17 mm long; limbs narrowly oblong, obliquely retuse to incised, ca. 5 × 1.5 mm; auricle ca. 0.8 mm long, claw 11–12 mm long. *Keel* 14–15 mm long; limbs obliquely oblong-curved, upper part with nearly rectangularly curved lower edge and concave upper edge, subacute, 4 × 1.5 mm, claw 10–11 mm long. *Stamen tube* slightly obliquely cut at the mouth. *Ovary* with a stipe 1.5–2 mm long, narrowly ellipsoid, white and black hairy; style glabrous. *Legumes* unknown.

Astragalus yechengensis differs from *A. kukunoricus* by being 25–35 cm tall (vs. 12–20 cm tall); peduncles 5–18 cm long, very sparsely to sparsely hairy (vs. 1–3 cm, rather densely hairy); calyx covered with black hairs 0.4–1.2 mm and white hairs up to 1.5 mm long (vs. black hairs 0.3–0.5 mm and slightly longer white hairs); and ovary with a stipe 1.5–2 mm long, white and black hairy (vs. subsessile, only white hairy).

X. Astragalus sect. **Komaroviella** Gontscharow, Fl. URSS 12: 876. 1946. TYPE: *Astragalus alpinus* L. (lectotype, designated by Barneby, 1964: 100).

1. Astragalus leptocladus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Urumqi, 2000 m, July 1957, s. coll. *245* (holotype, PE).

Differt ab *Astragalo alpino* L. caule saepissime singulare, ad 55 cm longo, internodiis ad 10 cm longis (nec nonnullis ad multis, 1–15 cm longis, internodiis valde brevioribus), pedunculis mere nigro-pilosis (nec albo-nigro-pilosis), leguminibus ca. 12 mm longis, distincte curvatis, bilocularibus (nec 8–10 mm longis, rectis vel parce curvatis, unilocularibus).

Plants 65 cm tall. *Caudex* slender. *Stems* 1 to 2, slender, up to 55 cm long, angular-sulcate, very sparsely covered with ± appressed black hairs 0.2–0.4 mm long, especially toward the nodes. *Stipules* greenish, 3–5 mm long, narrowly triangular, free from or very shortly adnate to the petiole, the lower ones vaginate-connate behind the stem up to the middle, the upper ones free from each other, sparsely covered with white and black hairs up to 1 mm long. *Leaves* 8–12 cm long; petiole 1–2 cm long, with the slender rachis sparsely hairy like the stem. *Leaflets* in 10 to 12 pairs, narrowly elliptic, 9–20 × 2–6 mm, rounded to subacute, mostly very minutely mucronulate, on upper side sparsely, on underside loosely covered with subappressed white hairs ca. 1 mm long. *Peduncles* 10–12 cm long, slender, erect, angular-sulcate, sparsely to rather loosely black hairy. *Racemes* at anthesis capitate, densely 12- to 15-flowered, slightly elongated at fruiting time. *Bracts* whitish membranous, ca. 2 mm long, narrowly triangular, black hairy. *Pedicels* ca. 1 mm, in fruit ca. 2 mm long, black hairy. *Calyx* campanulate, ca. 5 mm long, obliquely cut at the mouth, loosely to rather densely covered with subappressed black hairs 0.1–0.4 mm long; teeth filiform, 2–3 mm long, densely black hairy on inner side. *Petals* whitish with violet tip. *Standard* ca. 12 mm long; limb ca. 6 mm wide, ovate, widely and deeply emarginate, subabruptly passing into the short, cuneate claw. *Wings* ca. 10 mm long, distinctly shorter than standard and keel; limbs narrowly oblong, obtuse, 6 × 1 mm; auricle narrow, ca. 1 mm long, claw ca. 4 mm long. *Keel* ca. 11 mm long; limbs obliquely elliptic, middle part with widely curved lower edge and slightly concave upper edge, obtuse, ca. 7 × 3 mm; auricle acute, ca. 1 mm long, claw ca. 4 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* with a glabrous stipe 3–4 mm long, densely white hairy, becoming black hairy with age; style glabrous. *Legumes* spreading to nodding, with a stipe ca. 3 mm long, oblong, distinctly curved, ca. 12 mm long, ca. 3 mm high and ca. 2 mm wide, keeled

ventrally, grooved dorsally, with a slender beak ca. 2 mm long, bilocular; valves thin, loosely to rather densely covered with appressed to ascending or partly spreading black hairs 0.3–0.5 mm long.

Astragalus leptocladus differs from *A. alpinus* by usually having one singular stem up to 55 cm long, with internodes up to 10 cm long (vs. several to many stems 1–15 cm, with much shorter internodes); peduncles only black hairy (vs. white and black hairy); and legumes ca. 12 mm long, distinctly curved, bilocular (vs. 8–10 mm, straight or slightly curved, unilocular).

Etymology. The specific epithet derives from the Greek, and it means "with slender stem."

Paratype. CHINA. **Xinjiang:** near Urumqi, Nanshan, 1800 m, 10 July 1963, *S. Q. Wang 0064* (PE).

XI. Astragalus sect. **Laguropsis** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 137. 1868. TYPE: *Astragalus laguroides* Pallas (lectotype, designated by Podlech, 1990: 479).

1. Astragalus chamaephyton Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Wenquan, ca. 44°58′N, 81°06′E, 1710 m, 22 May 2004, *Zhao Yang Chang et al. 2004-309* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo laguroide* Pallas pilis in partibus vegetativis 0.5–0.8 mm (nec 0.8–1.1 mm) longis, stipulis ca. 3 mm (nec 6–7(–10) mm) longis, a tergo caulis alte connatis (nec inter se liberis), foliis 1.5–2.5 cm (nec 3–14 cm) longis, foliolis 2–3-jugis, 4–7 × 1.5–2.5 mm (nec 3–5(–8)-jugis, 8–25 × 3–8 mm), bracteis 2–2.5 mm (nec 5–10 mm) longis, calycibus 7–8 mm (nec 11–14 mm) longis, dentibus ca. 1 mm (nec 3–6 mm) longis, ovariis glabris (nec dense albopilosis).

Plants ca. 7 cm tall, acaulescent, in vegetative parts covered with medifixed, appressed white hairs 0.5–0.8 mm long. *Caudex* with a pluricipital root crown. *Stipules* whitish membranous, ca. 3 mm long, adnate to the petiole for ca. 1 mm, behind the stem highly connate, loosely to rather densely subappressed hairy. *Leaves* 1.5–2.5 cm long; petiole 0.5–1 cm long, sulcate adaxially, very densely hairy. *Leaflets* in 2 to 3 pairs, narrowly obovate, 4–7 × 1.5–2.5 mm, obtuse to subobtuse, on both sides densely hairy. *Peduncles* ca. 4 cm long, rather densely hairy like the rachis, toward the raceme with increasing black hairs. *Racemes* globular to ovoid, 2–3 cm long, densely ca. 12- to 15-flowered. *Bracts* whitish membranous, narrowly ovate, 2–2.5 mm long, with strongly asymmetrically bifurcate to basifixed white and black hairs. *Pedicels* ca. 1 mm long, black hairy. *Calyx* soon becoming ovoid-inflated, 7–8 mm long, loosely covered with strongly asymmetrically bifurcate to basifixed, tangled, spreading white and black hairs; teeth narrowly triangular, ca. 1 mm long, black, at the base white hairy on inner side. *Petals* violet. *Standard* ca. 15 mm long; limb ca. 5 mm wide, narrowly oblong, rounded, mostly slightly constricted above the lower 1/3, at the base obtuse-angularly passing into the cuneate claw. *Wings* ca. 14 mm long; limbs narrowly oblong, obliquely emarginate, 6 × 2 mm; auricle 0.8 mm long, claw ca. 8 mm long. *Keel* ca. 13 mm long; limbs slightly obliquely obovate, with widely curved lower edge and nearly straight upper edge, subacute, ca. 5 × 2 mm; auricle minute, claw ca. 8 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, glabrous. *Legumes* unknown.

Astragalus chamaephyton differs from *A. laguroides* by hairs in vegetative parts 0.5–0.8 mm long (vs. 0.8–1.1 mm); stipules ca. 3 mm long, behind the stem highly connate (vs. 6–7(–10) mm, free from each other); leaves 1.5–2.5 cm long (vs. 3–14 cm); leaflets in 2 to 3 pairs, 4–7 × 1.5–2.5 mm (vs. 3 to 5(to 8) pairs, 8–25 × 3–8 mm); bracts 2–2.5 mm long (vs. 5–10 mm); calyx 7–8 mm long, with teeth ca. 1 mm (vs. 11–14 mm, with teeth 3–6 mm); and ovary glabrous (vs. densely white hairy).

Etymology. The specific epithet is from the Greek "chamaephyton," meaning "low-growing plant."

XII. Astragalus sect. **Ornithopodium** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 100. 1868. TYPE: *Astragalus ornithopodioides* Lamarck (lectotype, designated by Podlech, 1990: 483).

1. Astragalus huochengensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Shawan, ca. 44°19′N, 85°34′E, 1287 m, 13 May 2004, *C. Y. Chang et al. 2004-192* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo leansanico* Ulbrich stipulis 3–5 mm longis, sparse ad laxe pilosis (nec 5–7 mm longis, glabris vel margine tantum ciliatis), calycibus 8–12 mm (nec 5–7 mm) longis, pilis ± medifixis (nec arcte asymmetrice bifurcatis) obtectis, vexillo 21–24 mm (nec 13–14 mm) longo.

Plants 15–30 cm tall, covered with appressed, ± medifixed hairs. *Caudex* up to 8 mm thick, with a pluricipital root crown, with short branches covered with gray-brown bark. *Stems* several, branched at the base, the old parts lignified, 2–5 cm long, ca. 1 mm thick, covered with gray-brown bark, decumbent to erect; parts of the current year 3–20 cm long, angular-sulcate, densely to very densely covered with white or black and white hairs 0.5–1 mm long, partly glabrescent with age. *Stipules* 3–5 mm long, very shortly

adnate to the petiole, the lower ones hyaline-membranous, behind the stem highly connate, often up to 3/4 of the length or higher, subglabrous to sparsely hairy, the upper ones often slightly greenish, shortly connate, with narrowly triangular free tips, sparsely to loosely hairy. *Leaves* 3–9 cm long; petiole 1–3 cm long, like the rachis slender, slightly sulcate adaxially, hairy like the stem. *Leaflets* in 5 to 10 pairs, narrowly elliptic, 5–10 × 1–3 mm, obtuse to minutely acuminate, on upper side glabrous or sparsely hairy, on underside loosely to rather densely covered with hairs 0.6–1 mm long. *Peduncles* 5–11 cm long, angular-sulcate, sparsely to loosely white or black and white hairy like the stem. *Racemes* rather densely 3- to 15-flowered, elongating in fruit. *Bracts* membranous, pale brownish, narrowly triangular, sometimes long-acuminate, 1.5–2 mm long, sparsely white and black hairy. *Pedicels* 1–2 mm long, white and black hairy. *Calyx* tubular, 8–12 mm long, slightly obliquely cut at the mouth, rather densely covered with ± medifixed, subappressed white and black hairs 0.3–1 mm long; teeth subulate, 1–3 mm long, sparsely hairy on inner side. *Petals* purple, wings and keel yellow. *Standard* 21–24 mm long; limb ca. 7 mm wide, narrowly rhombic-obovate, emarginate, gradually narrowed into a short claw. *Wings* 18–21 mm long; limbs narrowly oblong, obliquely minutely incised, ca. 7.5–8 × 2 mm; auricle ca. 0.5 mm long, claw 11–12 mm long. *Keel* 16–19 mm long; limbs obliquely elliptic, with widely curved lower edge and slightly concave curved upper edge, obtuse, ca. 6–6.5 × 2.5 mm; auricle short, claw 11–12 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile or subsessile, linear, white hairy; style glabrous. *Legumes* (unripe) sessile or subsessile, erect, linear, slightly to distinctly curved, at least 25 mm long, 2 mm high and wide, with a short, straight beak 1–2 mm long, bilocular; valves densely covered with symmetrically to asymmetrically bifurcate, appressed white hairs 0.5–0.8 mm long.

Astragalus huochengensis differs from *A. leansanicus* by stipules 3–5 mm long, sparsely to loosely hairy (vs. 5–7 mm, glabrous or ciliate at the margins only); calyx 8–12 mm long, with ± medifixed hairs (vs. 5–7 mm, with strongly asymmetrically bifurcate hairs); and standard 21–24 mm long (vs. 13–14 mm).

Etymology. Astragalus huochengensis is named after the town Huocheng in China.

Paratypes. CHINA. **Xinjiang:** near Huocheng, 1100 m, 16 June 1985, *Z. H. Wu 85-277* (WUK); near Shawan, 808 m, 13 May 2004, *C. Y. Chang et al. 2004-189* (MSB, WUK); near Ürümqi, 1700 m, 28 June 1987, s. coll. *nr. 1-224* (PE).

2. Astragalus maiusculus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: Toli, ca. 45°56′N, 83°37′E, 1 Sep. 1999, *D. F. Cui 93050* (holotype, PE).

Differt ab *Astragalo dsharkentico* Popov caulibus hornotinis densissime (nec laxe) pilosis, stipulis 5–9 mm (nec 2–3 mm) longis, pedunculis 2–4 cm (nec 5–15 cm) longis, bracteis 4–5 mm (nec 1.5–2 mm) longis, vexillo 25–27 mm (nec 20–22 mm) longo.

Plants ca. 20 cm tall. *Caudex* divided. *Stems* several, branched, the old parts lignified, with gray-black bark, the stems of the current year 1–5 cm long, very densely covered with ± medifixed, appressed to subappressed white hairs, near the nodes also black hairs, 0.8–1 mm long. *Stipules* greenish, 5–9 mm long, narrowly triangular, very shortly adnate to the petiole, shortly but distinctly vaginate-connate behind the stem, densely hairy. *Leaves* 5–15 cm long; petiole 3–9 cm long, like the rachis slender, grooved adaxially, sparsely to loosely covered with subappressed to ascending, symmetrically to strongly asymmetrically bifurcate hairs 0.8–1.5 mm long. *Leaflets* in 5 to 8 pairs, remote, elliptic, 5–10 × 2–6 mm, rounded, on both sides loosely covered with symmetrically to asymmetrically bifurcate, subappressed to slightly ascending hairs 1.2–2 mm long. *Peduncles* 2–4 cm long, loosely to rather densely white and black hairy like the rachis. *Racemes* short, densely 3- to 5-flowered. *Bracts* membranous, 4–5 mm long, ovate-acuminate to narrowly triangular, white and black or predominantly black hairy. *Pedicels* 3–4 mm long, black hairy. *Calyx* 13–14 mm long, tubular, slightly inflated, obliquely cut at the mouth, rather densely covered with symmetrically to asymmetrically bifurcate, subappressed to ascending, flexuose, on dorsal side and at the teeth predominantly black, on ventral side often predominantly white hairs 0.8–1 mm long; teeth subulate, 2–3 mm long, white hairy on inner side. *Petals* pale yellow. *Standard* 25–27 mm long; limb 10–11 mm wide, obovate, deeply and widely emarginate, gradually narrowed into the short widely cuneate claw. *Wings* 23–24 mm long; limbs narrowly oblong, obliquely and sometimes deeply emarginate, ca. 11 × 3 mm; auricle ca. 1 mm long, claw 11–12 mm long. *Keel* ca. 20 mm long; limbs obliquely obovate, with upper part widely, nearly rectangularly curved lower edge and slightly concave upper edge, obtuse, ca. 6–6.5 × 3 mm; auricle ca. 0.5 mm long, claw 13–14 mm long. *Stamen tube* truncate at the mouth. *Ovary* subsessile, linear, white hairy; style hairy only at the base. *Legumes* unknown.

Astragalus maiusculus differs from *A. dsharkenticus* by stems of the current year very densely hairy (vs.

loosely hairy); stipules 5–9 mm long (vs. 2–3 mm); peduncules 2–4 cm long (vs. 5–15 cm); bracts 4–5 mm long (vs. 1.5–2 mm); and standard 25–27 mm long (vs. 20–22 mm).

Etymology. The specific epithet is from the Latin "maiusculus," meaning "slightly taller," because the plant is slightly taller than *Astragalus dsharkenticus*.

3. Astragalus sadiensis Podlech, L. R. Xu & C. Y. Chang, sp. nov. TYPE: China. Xinjiang: Taokexun, 4 May 1959, *Xin-Tuo 0063* (holotype, PE; isotype, PE).

Differt ab *Astragalo hamiensi* S. B. Ho foliolis anguste ellipticis, 7–12 × 1.5–3 mm (nec ellipticis, 10–20 × 4–10 mm), petalis flavis (nec albidis vel roseis), leguminibus ca. 25 mm longis, breviter acuminatis (nec 25–40 mm longis, rostro distincto, 1–2 mm longo provisis).

Plants 20–25 cm tall, white hairy. *Caudex* with a pluricipital root crown and short branches. *Stems* few, slender, densely covered with medifixed, appressed hairs 0.5–0.8 mm long. *Stipules* ca. 3(–4) mm long, narrowly triangular, only those of lowest leaves shortly connate behind the stem, the others free from each other, all rather densely appressed hairy. *Leaves* ca. 4–5 cm long; petiole 1–1.5 cm long, with the rachis slender, densely hairy like the stem, at the insertion of the leaflets and petiole with ± spreading, strongly to extremely asymmetrically bifurcate hairs ca. 0.8 mm long. *Leaflets* in 4 pairs, narrowly elliptic, 7–12 × 1.5–3 mm, acute to shortly acuminate, on both sides loosely to rather densely covered with medifixed, appressed hairs 0.6–1 mm long. *Peduncles* 3–5 cm long, slender, hairy like the stem. *Racemes* loosely 2- to 10-flowered. *Bracts* 2–3 mm long, narrowly triangular, loosely hairy. *Pedicels* ca. 1 mm long, hairy. *Calyx* 7–10 mm long, tubular, slightly obliquely gibbous at the base, strongly obliquely cut at the mouth, loosely to rather densely covered with subappressed, ± medifixed white hairs 0.5–0.8 mm long, at the margins of teeth also with strongly asymmetrically bifurcate hairs; teeth subulate, unequal, 2–3 mm long. *Petals* yellow. *Standard* ca. 15 mm long; limb ca. 5 mm wide, emarginate, gradually narrowed into the short claw. *Wings* ca. 12 mm long; limbs narrowly oblong, ± obtuse, 5 × 1 mm; auricle ca. 0.5 mm long, claw 7 mm long. *Keel* ca. 12 mm long; limbs obliquely obovate, with widely curved lower edge and slightly concave upper edge, obtuse, 4.5 × 2 mm; auricle short, claw 7 mm long. *Stamen tube* slightly obliquely cut at the mouth. *Ovary* with a stipe ca. 1 mm long, linear, white hairy; style glabrous. *Legumes* (immature) ca. 25 mm long, 2 mm high, shortly acuminate; valves loosely covered with medifixed, appressed white hairs 0.5–0.8 mm long.

Etymology. The specific epithet is from the Chinese "sadi," meaning "desert."

Paratype. CHINA. **Xinjiang:** Taokexun, 10 June 1958, *A.-R. Li 7229* (KUN).

4. Astragalus supralaevis Podlech & L. R. Xu, sp. nov. TYPE: China. Yunnan: Daiching, Baima Shan mountains, 3300 m, 10 July 1981, *Qinghai-Xizang Team 2325* (holotype, KUN).

Differt ab *Astragalo leansanico* Ulbrich planta mere albopilosa (nec in inflorescentiis nigro-pilosa), stipulis basalibus tantum breviter a tergo caulis connatis, laxe ad densiuscule pilosis (nec omnibus alte connatis, glabris vel margine sparsissime ciliatis), foliis 10–16 cm (nec 3–6 cm) longis, bracteis 5–10 mm (nec 2–4 mm) longis, calyce pilis albis medifixis tantum obtecto (nec pilis partim maxime asymmetrice bifurcatis nigris obtecto).

Plants at least 35 cm tall (basal parts missing), covered with appressed, mostly ± medifixed white hairs 0.3–0.5 mm long. *Stems* loosely to rather densely hairy. *Stipules* greenish, linear-acute to subulate, 6–10 mm long, very shortly adnate to the petiole, only those of lowest leaves shortly connate behind the stem, all others free from each other, loosely to rather densely hairy. *Leaves* 10–16 cm long; petiole 2–2.5 cm long, hairy like the stem. *Leaflets* in 9 to 12 pairs, narrowly elliptic, 12–22 × 4–9 mm, obtuse to rounded, on upper side glabrous, on underside sparsely to loosely hairy. *Peduncles* 10–11 cm long, hairy like the stem. *Racemes* loosely many-flowered, elongating in fruit, up to 8 cm long. *Bracts* greenish, linear-acute, 5–10 mm long, loosely to rather densely hairy. *Pedicels* 1–1.5 mm long, hairy. *Calyx* campanulate, ca. 8 mm long, rather densely to densely hairy; teeth subulate, unequal, the upper (adaxial) ca. 2 mm, the lower (abaxial) ca. 3 mm long, hairy on inner side. *Petals* pink. *Standard* ca. 13 mm long; limb ca. 5 mm wide, obovate to elliptic, emarginate, gradually narrowed into the rather long claw. *Wings* ca. 12 mm long; limbs narrowly oblong to slightly dilated upward, rounded, 6 × 2 mm; auricle ca. 1 mm long, claw 6 mm long. *Keel* 10 mm long; limbs obliquely obovate, upper part with widely curved lower edge and nearly straight to slightly curved upper edge, obtuse, 5 × 2.5 mm; auricle short, claw 5 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* sessile or subsessile, glabrous. *Legumes* (unripe) sessile, linear, slightly curved, ca. 15 mm long, 3 mm high, with a short, straight beak ca. 2 mm long; valves loosely hairy, soon glabrescent.

Astragalus supralaevis differs from *A. leansanicus* by being white hairy (vs. on inflorescence black

hairy); only the basal stipules shortly connate behind the stem, all loosely to rather densely hairy (vs. all highly connate, glabrous or at the margin very sparsely ciliate); leaves 10–16 cm long (vs. 3–6 cm); bracts 5–10 mm long (vs. 2–4 mm); and only the calyx covered with white medifixed hairs (vs. partly with strongly asymmetrically bifurcate black hairs).

Etymology. The specific epithet is from the Latin "supralaevis," meaning "smooth above," because the leaflets are glabrous on the upper side.

XIII. Astragalus sect. **Oroboidei** A. Gray, Proc. Amer. Acad. 6: 203. 1864. TYPE: *Astragalus oroboides* Hornemann.

1. Astragalus gongshanensis Podlech & L. R. Xu, sp. nov. TYPE: China. Yunnan: Gongshan, 2200–2500 m, 29 May 1940, *K. M. Feng 7076* (holotype, PE).

Differt ab *Astragalo taipaishanensi* Y. C. Ho & S. B. Ho stipulis 2–4 mm longis, lineari-acutis (nec 5–10 mm longis, oblongis ad anguste triangularibus), bracteis ad 3 mm (nec ad 5 mm) longis, pedicellis ca. 1 mm (nec 2–5 mm) longis), calyce pilis subappressis ad patentibus, flexuosis, implexis 0.1–0.5 mm longis obtecto (nec pilis subappressis, rectis, 0.5–0.8 mm longis obtecto), dentibus non in latere abaxiali congestis, vexillo ca. 10 × 4 mm (nec 12–14 × 6 mm), ovariis stipite ca. 1.5 mm longo suffultis (nec subsessilibus).

Plants ca. 30 cm tall, loosely hairy. *Caudex* unknown. *Stems* ascending to erect, branched with short non-flowering side branches, striate, sparsely to loosely covered with appressed to spreading black hairs 0.3–0.7 mm long, with some white hairs mixed in. *Stipules* greenish, 2–4 mm long, linear-acute, free from petiole and from each other, sparsely hairy to subglabrous, ciliate at the margins and with minute glands. *Leaves* 5–8 cm long; petiole 1–2 cm long, with the rachis slender, hairy like the stem. *Leaflets* in 5 to 8 pairs, dull green on upper side, lighter on underside, narrowly elliptic to narrowly obovate, 8–20 × 3–8 mm, obtuse to retuse, on upper side glabrous, on underside loosely covered with subappressed white hairs 0.4–0.8 mm long. *Peduncles* 7–9 cm long, slender, loosely hairy like the stem. *Racemes* loosely ca. 12- to 20-flowered. *Bracts* membranous, very narrowly triangular, 2–3 mm long, white and black hairy, at the base with minute glands. *Pedicels* ca. 1 mm long, white and black hairy. *Calyx* shortly tubular, 5–6 mm long, at the base obliquely gibbous, slightly obliquely cut at the mouth, loosely, toward the teeth more densely, covered with subappressed to spreading, tangled, flexuose black and white hairs 0.1–0.5 mm long; teeth unequal, the upper (adaxial) ones narrowly triangular, ca. 1 mm long, the lower (abaxial) ones triangular, 0.3–0.5 mm long, hairy on inner side. *Petals* yellow. *Standard* ca. 10 mm long; limb ca. 4 mm wide, oblong, emarginate, contracted into a short, wide claw. *Wings* ca. 9 mm long; limbs narrowly oblong, slightly curved, obtuse, ca. 4 × 1 mm; auricle ca. 1.2 mm long, claw ca. 5 mm long. *Keel* ca. 8.5 mm long; limbs obliquely triangular-elliptic, middle part with rectangularly curved lower edge and nearly straight upper edge, subobtuse, ca. 4 × 2 mm; auricle acute, ca. 1 mm long, claw 4.5 mm long. *Stamen tube* truncate at the mouth. *Ovary* with stipe ca. 1.5 mm long, glabrous. *Legumes* unknown.

Astragalus gongshanensis differs from *A. taipaishanensis* by stipules 2–4 mm long, linear-acute (vs. 5–10 mm, oblong to narrowly triangular); bracts up to 3 mm long (vs. up to 5 mm); pedicels ca. 1 mm long (vs. 2–5 mm); calyx covered with subappressed to spreading flexuose, tangled hairs 0.1–0.5 mm long (vs. subappressed straight hairs 0.5–0.8 mm); standard ca. 10 × 4 mm (vs. 12–14 × 6 mm); and ovary with a stipe ca. 1.5 mm long (vs. subsessile).

XIV. Astragalus sect. **Poliothrix** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 48. 1868. TYPE: *Astragalus leucocephalus* Bentham.

1. Astragalus baxoiensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xizang: near Baxoi City, ca. 30°01′N, 96°55′E, 4200 m, 27 Aug. 1973, *Qinghai-Xizang Exped. 73-1283* (holotype, KUN).

Differt ab *Astragalo cobresiiphilo* Podlech & L. R. Xu caulibus rhachidibus, pedunculisque glabris (nec sparse ad laxe appresse pilosis), ovariis leguminibusque glabris (nec pilis nigris obtectis).

Plants 6–12 cm tall, densely caespitose, with appressed hairs. *Caudex* with a pluricipital root crown and numerous, very short subterranean branches. *Stems* diffusely prostrate to ascending, up to 6 cm long, slender, angular-sulcate, glabrous. *Stipules* greenish, often reflexed, 2–3 mm long, narrowly triangular, nearly free from the petiole, distinctly connate behind the stem, sparsely hairy to sometimes glabrous. *Leaves* 1.5–4.5 cm long; petiole 0.5–1 cm long, like the rachis slender, grooved adaxially, glabrous or with scattered hairs up to 0.3 mm long. *Leaflets* in 5 to 8(to 9) pairs, elliptic, 2–3 × 1–1.5 mm, subobtuse, on upper side glabrous, on underside especially at the midvein sparsely covered with appressed hairs up to 0.3 mm long. *Peduncles* several in upper leaf axils, 2–3.5 cm long, slender, glabrous. *Racemes* short, rather densely 4- to 8-flowered. *Bracts* whitish membranous, ovate to narrowly triangular, 1–2 mm long, sparsely white and black hairy. *Pedicels* 1–1.5 mm long, sparsely black hairy. *Calyx* campanulate, ca. 3 mm long, slightly

obliquely cut at the mouth, loosely covered with appressed white and black hairs 0.1–0.3 mm long; teeth narrowly triangular, 1–1.5 mm long, sparsely hairy on inner side. *Petals* pale purple. *Standard* ca. 8 mm long; limb widely elliptic to orbicular, ca. 4.5 mm wide, emarginate, at the base gradually narrowed without distinct claw. *Wings* ca. 7 mm long; limbs narrowly oblong, obtuse, 5 × 1.5 mm; auricle 0.5 mm long, claw 3 mm long. *Keel* 6 mm long; limbs obliquely obovate, with widely curved lower edge and sigmoid upper edge, subobtuse, 3 × 2 mm; auricle minute, claw 3 mm long. *Stamen tube* truncate at the mouth. *Ovary* with a stipe ca. 1 mm long, glabrous. *Legumes* with a stipe ca. 1 mm long, ellipsoid, ca. 5 mm long, 2 mm high and 2.5 mm wide, keeled ventrally, grooved dorsally, acute with the hooked persistent style, unilocular; valves thin, pale brownish, glabrous. *Seeds* 1.5 × 1 mm, blackish brown.

Astragalus baxoiensis differs from *A. cobresiiphilus* by stems, rachides, and peduncles glabrous (vs. sparsely to loosely hairy), and ovary and legumes glabrous (vs. black hairy).

Etymology. *Astragalus baxoiensis* is named for the city Baxoi, China.

2. Astragalus jiazaensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xizang: Jiaza, 3400 m, 2 Aug. 1982, *C. C. Ni et al. 2729* (holotype, PE).

Differt ab *Astragalo tibeticola* Podlech & L. R. Xu stipulis foliorum superiorum inter se liberis, foliolis 11–15-jugis (nec 9–11-jugis) acutis vel acuminatis (nec rotundatis ad emarginatis), calyce 3–4 mm (nec 4–5 mm) longo, vexillo ca. 7 × 3–3.5 mm, late obovato (nec 6–7 × 5 mm, transverse elliptico), legumine uniloculari (nec semibiloculari).

Plants up to 25 cm tall. *Caudex* divided with short, subterranean branches. *Stems* several, ± erect, sparsely to loosely covered with subappressed to slightly ascending white hairs 0.2–0.6 mm long, with some shorter black hairs mixed in. *Stipules* greenish, 5–6 mm long, narrowly triangular to narrowly ovate, acuminate, the lower ones shortly connate behind the stem, the upper ones free from each other, all sparsely to loosely covered with subappressed hairs, at the margins with ± spreading white hairs 0.4–1 mm long, with some short black hairs mixed in. *Leaves* 6–10 cm long, the upper ones subsessile, the lower ones with a petiole 1.5–2.5 cm long; rachis slender, sulcate adaxially, sparsely hairy like the stem. *Leaflets* in 11 to 15 pairs, narrowly elliptic to elliptic, 8–15 × 1–4 mm, acute to acuminate, on upper side glabrous, on underside loosely covered with subappressed hairs 0.4–0.6 mm long. *Peduncles* 4–7 cm long, sparsely hairy like the stem. *Racemes* 2.5–4 cm long, rather densely many-flowered; axis hairy like the peduncle. *Bracts* membranous, narrowly triangular, 1.5–2(–3) mm long, predominantly black hairy, at the margins with minute glands. *Pedicels* ca. 0.5 mm long, black hairy. *Calyx* 3–4 mm long, campanulate, obliquely cut at the mouth, loosely covered with subappressed black and white hairs 0.2–0.5 mm long; teeth unequal, the upper (ventral) narrowly triangular, 0.5–0.8 mm long, the lower (dorsal) 3 subulate, 1.5–1.8 mm long, all black hairy on inner side. *Petals* pale violet with deep purple keel tip. *Standard* ca. 7 mm long; limb ca. 3–3.5 mm wide, widely obovate, deeply emarginate, subabruptly contracted into the short, cuneate claw. *Wings* ca. 5.5 mm long; limbs narrowly oblong, obtuse, ca. 3.5 × 1 mm; auricle ca. 0.5 mm long, claw ca. 2 mm long. *Keel* 4.5 mm long; limbs obliquely obovate, with widely curved lower edge and slightly curved upper edge, obtuse, 2.5 × 1.5 mm; claw ca. 2 mm long. *Stamen tube* obliquely cut at the mouth. *Legumes* sessile, narrowly ellipsoid, curved, 6–7 mm long, ca. 2.5 mm high and wide, keeled ventrally, rounded dorsally, very shortly acuminate, unilocular; valves loosely covered with appressed black hairs 0.2–0.3 mm long, glabrescent with age. *Seeds* ca. 4, dark brown, 2 × 1 mm.

Astragalus jiazaensis differs from *A. tibeticola* by stipules of upper leaves free from each other (vs. connate behind the stem); leaflets in 11 to 15 pairs, acute or acuminate (vs. in 9 to 11 pairs, rounded to emarginate); calyx 3–4 mm long (vs. 4–5 mm); standard ca. 7 × 3–3.5 mm, widely obovate (vs. 6–7 × 5 mm, transversely elliptic); and legumes unilocular (vs. incompletely bilocular).

Etymology. *Astragalus jiazaensis* is named for the city Jiaza, China.

Paratypes. CHINA. **Xizang:** Miling, 2900 m, 24 Aug. 1974, *Qinghai-Xizang Team 74-1866* (KUN); near Lhasa, 3900 m, 31 Aug. 1965, *J. T. Zhang & K. Y. Lang 2231* (PE).

XV. Astragalus sect. **Skythropos** N. D. Simpson, Notes Roy. Bot. Gard. Edinburgh 8: 255. 1915. TYPE: *Astragalus skythropos* Bunge.

1. Astragalus yunnanensis Franchet subsp. **incanus** (E. Peter) Podlech & L. R. Xu, comb. et stat. nov. Basionym: *Astragalus tatsiensis* f. *incanus* E. Peter, Acta Horti Gothob. 12: 54. 1937. TYPE: China. Yunnan: Bei-ma-shan, s.d., *G. Forrest 14412* (lectotype, designated by Wenninger, 1991, E; isotypes, BM, K, W).

Astragalus yunnanensis subsp. *incanus* differs from subspecies *yunnanensis* Franchet by leaflets villous, densely to very densely covered on both sides with ascending to spreading, flexuose, tangled white hairs

0.5–1 mm long (vs. leaflets on upper side glabrous or sparsely to loosely hairy, on underside loosely to densely hairy, sometimes only at the midvein and margins, rarely glabrous). Besides the morphological differences, it is endemic in a restricted area of northwestern Yunnan and adjacent Sichuan. The status of subspecies is therefore appropriate.

XVI. Astragalus sect. **Trachycercis** Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 114. 1868. TYPE: *Astragalus humilis* M. Bieberstein (lectotype, designated by Podlech, 1990: 490).

Astragalus acceptus Podlech & L. R. Xu, sp. nov. TYPE: China. Qinghai: Chaidamu (Delingha), ca. 37°22′N, 97°23′E, 3400 m, 27 July 1959, *Exped. Gansu et Qinghai Acad. Sin. 1029* (holotype, PE).

Differt ab *Astragalo porphyreo* Podlech & L. R. Xu vexillo 22 × 6–7 mm (nec 16–17 × 4.5–5.5 mm), alis ca. 19 mm (nec 14–15 mm) longis, carina 18 mm (nec 12–13 mm) longa, foliolis 3–4-jugis (nec 1–2-jugis), bracteis ca. 7 mm (nec ca. 3 mm) longis.

Plants 4–5 cm tall, acaulescent, densely caespitose, only white hairy. *Caudex* with a pluricipital root crown with short, divided branches, covered in upper part densely with remnants of old stipules. *Stipules* whitish membranous, 5–8 mm long, narrowly triangular, adnate to the petiole for ca. 3 mm, densely covered with ± symmetrically to asymmetrically bifurcate, subappressed hairs 1–1.5 mm long. *Leaves* 2–6 cm long; petiole 1–3 cm long, like the rachis slender, densely covered with ± medifixed, subappressed hairs 0.4–0.6 mm long. *Leaflets* in 3 to 4 pairs, elliptic, 4–8 × 1.8–3 mm, subacute to obtuse, on upper side sparsely, on underside rather densely covered with medifixed, appressed hairs ca. 1 mm long. *Racemes* sessile, 1- to 2-flowered. *Bracts* whitish membranous, narrowly triangular, ca. 7 mm long, sparsely covered with basifixed hairs 0.8–1 mm long, at the margins with minute glands. *Flowers* sessile. *Calyx* campanulate-tubular, 9–10 mm long; densely covered with strongly asymmetrically bifurcate to basifixed, flexuose, tangled white hairs 0.7–1 mm long; teeth narrowly triangular, 2.5–3 mm long, hairy on inner side. *Petals* yellowish when dry. *Standard* ca. 22 mm long; limb 6–7 mm wide, oblong, emarginate, slightly constricted below the middle, subabruptly contracted into the claw ca. 5 mm long. *Wings* ca. 19 mm long; limbs narrowly oblong, laterally incised, 9 × 2 mm; auricle ca. 0.5 mm, claw 11 mm long. *Keel* 18 mm long; limbs obliquely elliptic-curved, with widely curved lower edge and slightly concave upper edge, subacute. *Stamen tube* truncate at the mouth. *Ovary* sessile, white hairy.

Astragalus acceptus differs from *A. porphyreus* by standard 22 × 6–7 mm (vs. 16–17 × 4.5–5.5 mm); wings ca. 19 mm long (vs. 14–15 mm); keel 18 mm long (vs. 12–13 mm); leaflets in 3 to 4 pairs (vs. 1 to 2 pairs); and bracts ca. 7 mm long (vs. ca. 3 mm).

Etymology. The specific epithet is from the Latin "acceptus," meaning "accepted."

2. Astragalus brevivexillatus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Burqin, ca. 47°41′N, 86°59′E, 490 m, 29 May 2004, *Zhao-Yang Chang et al. 2004-408* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo gregorii* B. Fedtschenko & Basilevskaja foliolis 2–3(–4)-jugis (nec unijugis), pilis 2–2.5 mm (nec 0.6–0.8 mm) longis instructis, calyce pilis basifixis albis ± patentibus (nec pilis medifixis praecipue nigris, appressis) obtecto, dentibus filiformibus 3–5 mm longis (nec dentibus 1.5–2 mm longis), vexillo ca. 12 mm longo (nec ca. 21 mm longo).

Plants 5–6 cm tall, acaulescent, caespitose, with only white hairs. *Caudex* with a pluricipital root crown. *Stipules* whitish membranous, ca. 2 mm long, narrowly triangular, shortly adnate to the petiole, hairy like the rachis. *Leaves* 3–6 cm long; petiole 2–4 cm long, like the rachis densely covered with appressed, symmetrically to asymmetrically bifurcate hairs ca. 1 mm long. *Leaflets* 2- to 3(4)-paired, narrowly elliptic to elliptic, 7–15 × 3–5 mm, acute, on both sides densely covered with ± medifixed, appressed hairs 2–2.5 mm long. *Racemes* sessile, 3- to 4-flowered. *Bracts* whitish membranous, 4–7 mm long, very narrowly triangular, with basifixed hairs up to 1 mm long. *Flowers* subsessile. *Calyx* whitish membranous, ca. 8 mm long, campanulate-tubular, rather densely covered with subbasifixed to basifixed, ascending to spreading, tangled hairs ca. 1 mm long; teeth filiform, 3–5 mm long. *Petals* white. *Standard* ca. 12–13 mm long; limb ca. 4 mm wide, oblong, rounded or minutely emarginate, below the middle slightly constricted, angularly passing into the cuneate claw. *Wings* ca. 12 mm long; limbs narrowly oblong, obtuse, ca. 5 × 1.3 mm; auricle minute, claw 12 mm long. *Keel* ca. 9 mm long; limbs obliquely elliptic, with widely curved lower and upper edge, subobtuse, ca. 3.5 × 2 mm; auricle indistinct, claw ca. 6 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, ellipsoid, white hairy; style hairy in basal part. *Legumes* sessile, obliquely ellipsoid, ca. 5 mm long, 2 mm high and wide, keeled ventrally, widely flattened dorsally, with a rigid beak 4–5 mm long, incompletely bilocular; valves thin, straw-colored, densely covered with appressed to ascending,

tangled medifixed to basifixed hairs 0.5–1 mm long. *Seeds* 2 in each locule.

Astragalus brevivexillatus differs from *A. gregorii* by leaflets in 2 to 3(to 4) pairs, covered with hairs 2–2.5 mm long (vs. in 1 pair, with hairs 0.6–0.8 mm); calyx covered with basifixed, spreading white hairs, with teeth 3–5 mm long (vs. covered with medifixed, appressed, predominantly black hairs, with teeth 1.5–2 mm); and standard ca. 12 mm long (vs. ca. 21 mm).

Etymology. The specific epithet is from the Latin "brevivexillatus," meaning "short standard."

Paratypes. CHINA. **Xinjiang:** near Altai city, 790 m, 1 June 2004, *Zhao-Yang Chang et al. 2004-470a* (MSB, WUK); near Burqin, 524 m, 29 May 2004, *Zhao-Yang Chang et al. 2004-460* (MSB, WUK), 450 m, 1 July 1996, *L.-R. Xu 96-132* (MSB); Fuhai, Keke Tuohai, 865 m, 3 June 2004, *Zhao-Yang Chang et al. 2004-498* (MSB); near Toli, 800 m, 26 May 2004, *Zhao-Yang Chang et al. 2004-367* (MSB, WUK); near Taoli, Laufengkou, 550 m, 5 July 1996, *L.-R. Xu 96-165* (MSB); near Jinghe, 688 m, 14 May 2004, *Zhao-Yang Chang et al. 2004-205* (MSB, WUK); Hoboksar, 1274 m, 27 May 2004, *Zhao-Yang Chang et al. 2004-205* (MSB, WUK); near Ürümqui, 900 m, 10 May 2004, *Zhao-Yang Chang et al. 2004-168* (MSB, WUK), 1000 m, 29 May 1958, *A.-R. Li 6009* (MSB).

3. Astragalus filidens Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Sailimu, 44°37′N, 81°22′E, 2091 m, 28 May 2004, *Zhao Yang Chang et al. 2004-382* (holotype, WUK; isotype, MSB).

Differt ab omnibus speciebus sectionis vexillo alisque pilosis.

Plants 6–8 cm tall, acaulescent or subacaulescent, caespitose, densely covered with ascending to spreading, bifurcate, white hairs. *Caudex* divided, with short subterranean branches. *Stems*, if present, up to 2 cm long, densely covered with symmetrically to asymmetrically bifurcate, ascending to spreading, flexuose, tangled hairs 0.5–0.8 mm long. *Stipules* whitish, 3–5 mm long, narrowly triangular, shortly adnate to the petiole, hairy like the stem. *Leaves* 3–6 cm long; petiole 1–2.5 cm long, like the rachis densely covered with symmetrically to asymmetrically bifurcate, ascending to spreading, tangled hairs 0.5–0.8 mm long and with strongly asymmetrically bifurcate, spreading hairs up to 2.5 mm long. *Leaflets* in 5 to 9 pairs, narrowly elliptic to elliptic, 4–9 × 2–3 mm, subacute, partly folded, on both sides densely covered with symmetrically to asymmetrically bifurcate, ascending to partly spreading, tangled hairs 1.5–2.5 mm long. *Racemes* subsessile, ca. 4- to 5-flowered. *Bracts* greenish, linear, acute, 7–8 mm long, with mostly strongly asymmetrically bifurcate hairs 0.8–1.5 mm long. *Flowers* subsessile. *Calyx* whitish membranous, tubular, obliquely cut at the mouth, 10–12 mm long, densely covered with mostly strongly asymmetrically bifurcate, ascending to spreading, tangled hairs 1.5–2.5 mm long; teeth filiform, greenish, 5–6 mm long, densely hairy on inner side. *Petals* whitish or yellow; adaxial standard and outer wings loosely covered with ± asymmetrically bifurcate, flexuose, appressed hairs. *Standard* ca. 15 mm long; limb ca. 4–4.5 mm wide, oblong-panduriform, emarginate, below the middle distinctly constricted, toward the base widened and obtuse-angularly passing into the short, cuneate claw. *Wings* ca. 14 mm long; limbs narrowly oblong, distinctly incised, ca. 7 × 1.5 mm; auricle ca. 0.5 mm long, claw ca. 7 mm long. *Keel* ca. 10 mm long; limbs narrowly elliptic, with widely curved lower edge and ± straight upper edge, subacute, ca. 4 × 2 mm; auricle indistinct, claw ca. 6 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely white hairy. *Legumes* unknown.

Astragalus filidens differs from all species of the section *Trachycercis* by its hairy standard and wings.

Etymology. The specific epithet is from the Latin "filidens," meaning "with long, thin teeth" (i.e., calyx teeth).

4. Astragalus glabritubus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Toli, 45°56′N, 83°37′E, 1800 m, 24 May 2004, *Zhao Yang Chang et al. 2004-321* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo parvicarinato* S. B. Ho, cui ob carinam perbrevem similis, stipulis 5–7 mm (nec 1–3 mm) longis, margine ciliatis ceterum glabris (nec dense villosis), foliis 1–2.5 cm (nec 3–8 cm) longis, foliolis saepissime unijugis (nec 2–3-jugis), calycis tubo glabro (nec patenter piloso).

Plants 3–4 cm tall, acaulescent, very densely compactly caespitose, white hairy. *Caudex* divided with blackish subterranean branches up to 3 cm long, covered with remnants of old stipules and petioles. *Stipules* 5–7 mm long, adnate to the petiole up to the middle, free tips narrowly ovate, obtuse, at the margins with spreading, basifixed cilia ca. 0.8 mm long, otherwise glabrous. *Leaves* 1–2.5 cm long; petiole 0.6–1.8 cm long, like the rachis slender, densely covered with medifixed, appressed hairs 0.4–0.6 mm long. *Leaflets* in 1(to 2) pairs, narrowly obovate, 4–9 × 1.5–2.2 mm, subobtuse, mostly folded, on both sides loosely to rather densely covered with medifixed, appressed hairs 0.5–0.8 mm long. *Racemes* sessile, 2- to 3-flowered. *Bracts* greenish, 8–12 mm long, from narrowly ovate base long, linear-acute, at the margins comb-like ciliate with basifixed hairs. *Flowers* sessile. *Calyx* ca. 8–10 mm long,

campanulate, whitish membranous, tube glabrous; teeth subulate, ca. 4 mm long, at the margins comb-like ciliate with basifixed hairs up to 0.8 mm long. *Petals* white. *Standard* ca. 20 mm long; limb narrowly obovate, ca. 5 mm wide, emarginate, long and gradually narrowed at the base. *Wings* ca. 15 mm long; limbs narrowly oblong, obliquely retuse, ca. 10 × 1.5 mm; auricle 0.3 mm long, claw ca. 5 mm long. *Keel* ca. 9 mm long; limbs elliptic, subacute, ca. 4.5 × 2 mm, subacute; auricle indistinct, claw ca. 4.5 mm long. *Stamen tube* truncate at the mouth. *Ovary* shortly stipitate, subglobular, appressed white hairy; style glabrous. *Legumes* unknown.

Astragalus glabritubus similar to *A. parvicarinatus* by its very short keel but differs by stipules 5–7 mm long, ciliate only at the margins (vs. 1–3 mm, densely villous); leaves 1–2.5 cm long with leaflets mostly in 1 pair (vs. 3–8 cm, with leaflets in 2 to 3 pairs); and calyx tube glabrous (vs. spreadingly hairy).

Etymology. The specific epithet is from the Latin "glabritubus," meaning "with glabrous tube" (i.e., calyx tube).

5. Astragalus levidensis Podlech & L. R. Xu, sp. nov. TYPE: China. Qinghai: near Tianjun City, ca. 37°18′N, 99°04′E, 3400 m, 1 Aug. 1959, s. coll. *nr. 1143* (holotype, PE).

Differt ab *Astragalo scaberrimo* Bunge stipulis petiolo per 3–4 mm (nec 1.5–2.5 mm) adnatis, racemis sessilibus, 1–3-floribus (nec pedunculo 0.3–1.4(–4) cm longo suffultis, 3–5-floribus), bracteis 7–8 mm (nec 2–3 mm) longis, calycibus pilis maxime asymmetrice bifurcatis ad basifixis, implexis, flexuosis, ± patentibus (nec pilis ± medifixis appressis) obtectis.

Plants 5–8 cm tall, acaulescent or nearly so, caespitose, mostly appressed hairy. *Caudex* strongly divided, with many short subterranean branches, densely covered with remnants of old stipules. *Stipules* 5–8 mm long, narrowly triangular, acuminate, adnate to the petiole for 3–4 mm, densely covered with symmetrically to strongly asymmetrically bifurcate, at the margins also basifixed white hairs 0.5–1.5 mm long, at the margins with minute sessile glands. *Leaves* (1.5–)2–5 cm long; petiole (0.5–)1–2.5 cm long, like the rachis slender, rather densely to densely covered with ± medifixed white hairs 0.4–0.5 mm long. *Leaflets* in 4 to 6 pairs, elliptic, 3–7 × 1–3 mm, subacute to rounded, on both sides loosely or on underside more densely covered with medifixed hairs 0.5–0.7 mm long. *Racemes* sessile, 1- to 3-flowered. *Bracts* membranaceous, 7–8 mm long, narrowly triangular to narrowly ovate, white hairy. *Flowers* nearly sessile. *Calyx* tubular, 7–9 mm long, densely covered with strongly asymmetrically bifurcate, flexuose, tangled, ± spreading white hairs 1–1.2 mm long; teeth subulate, ca. 2 mm long, densely white hairy on inner side. *Petals* yellow when dry. *Standard* 20–21 mm long; limb obovate, ca. 7 mm wide, emarginate, slightly angularly passing into the short cuneate claw. *Wings* 17–18 mm long; limbs narrowly oblong, slightly dilated toward the distinctly, obliquely incised tip, ca. 8 × 2.5 mm; auricle ca. 0.8 mm long, claw ca. 10 mm long. *Keel* ca. 15 mm long; limbs elliptic, with slightly curved lower and upper edge, rounded, ca. 7 × 3 mm; auricle short. *Stamen tube* truncate at the mouth. *Ovary* sessile, narrowly oblong, white hairy; style long, glabrous. *Legumes* unknown.

Astragalus levidensis differs from *A. scaberrimus* by stipules adnate to the petiole for 3–4 mm (vs. 1.5–2.5 mm); racemes sessile, 1- to 3-flowered (vs. with a peduncle 0.3–1.4(–4) cm, 3- to 5-flowered); bracts 7–8 mm long (vs. 2–3 mm); and calyx with strongly asymmetrically bifurcate to basifixed, flexuose, tangled hairs (vs. with ± medifixed, appressed hairs).

Etymology. The specific epithet is from the Latin "levidensis," meaning "insignificant."

6. Astragalus lustricola Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: Huocheng, 44°03′N, 80°52′E, 975 m, 15 May 2004, *Zhao Yang Chang et al. 2004-215* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo hsinbatico* P. Y. Fu & Y. A. Chen stipulis viridiusculis, 5–6 mm longis, a petiolo liberis (nec albido-membranaceis, 7–10 mm longis, petiolo per ca. 2 mm adnatis), pilis ad 1 mm (nec ad 2 mm) longis instructis, racemis pedunculo ad 3 cm longo suffultis (nec subsessilibus), calyce pilis nigris immixtis (nec mere albo-piloso), vexillo ca. 20 × 8 mm, obovato (nec 22–28 × 6 mm, anguste obovato), leguminibus rostro 3–4 mm longo instructis (nec breviter acuminatis).

Plants 5–8 cm tall, acaulescent or nearly so, covered with ascending to spreading, bifurcate hairs. *Stems*, if present, very short, very densely tomentose. *Stipules* greenish, 5–6 mm long, narrowly triangular, free from the petiole, sparsely to loosely furnished with medifixed to basifixed, subappressed to spreading hairs 0.8–1 mm long. *Leaves* 7–9 cm long; petiole 1.5–3 cm long, like the rachis densely covered with ± medifixed, partly flexuose, tangled, ascending to spreading white hairs 0.5–0.8 mm long and with fewer, strongly to extremely asymmetrically bifurcate, straight, spreading hairs 1–1.5 mm long. *Leaflets* in 7 to 11 pairs, elliptic to obovate or narrowly elliptic, 7–10 × 2–7 mm, obtuse, minutely mucronulate, on both sides rather densely covered with ascending, straight or flexuose, ± medifixed hairs 1–1.5 mm long. *Racemes* 6- to 10-flowered, with a pedun-

cle hairy like the rachis. *Bracts* membranous to slightly greenish, narrowly triangular, ca. 5–6 mm long, furnished with ± spreading white hairs up to 1.5 mm long, with short black hairs mixed in, at the margins with basifixed hairs. *Calyx* whitish membranous, tubular, obliquely cut at the mouth, 15–16 mm long, densely covered with flexuose, ± medifixed, subappressed to ascending white hairs 0.8–1 mm long and with strongly asymmetrically bifurcate, spreading white hairs up to 2 mm long, with some short, medifixed black hairs mixed in; teeth subulate, 4–5 mm long, densely appressed white hairy on inner side. *Petals* yellowish. *Standard* ca. 20 mm long; limb ca. 8 mm wide, obovate, emarginate, distinctly constricted in the middle, subabruptly contracted into the claw ca. 6 mm long. *Wings* ca. 20 mm long; limbs narrowly elliptic, obtuse, ca. 7 × 2.5 mm; auricle 0.5 mm long, claw slender, 13–14 mm long. *Keel* ca. 17 mm long; limbs obliquely elliptic-curved, with widely curved lower edge and concave upper edge, obtuse, ca. 5 × 2.5 mm; auricle ca. 0.5 mm long, claw ca. 12 mm long. *Stamen tube* nearly truncate at the mouth. *Ovary* sessile, densely white hairy; style hairy at the base. *Legumes* (unripe) ca. 15 mm long, 3 mm high, keeled ventrally, rounded dorsally, with a beak 3–4 mm long; valves densely covered with subappressed, flexuose, ± medifixed white hairs ca. 0.5 mm long and with strongly asymmetrically bifurcate, straight, spreading hairs 1.5–2 mm long.

Astragalus lustricola differs from *A. hsinbaticus* by greenish stipules 5–6 mm long, free from the petiole, with hairs ca. 1 mm long (vs. white-membranous, 7–10 mm, adnate to the petiole for ca. 2 mm, with hairs up to 2 mm); racemes with a peduncle up to 3 cm long (vs. subsessile); calyx with white and black hairs (vs. only with white hairs); standard ca. 20 × 8 mm, obovate (vs. 22–28 × 6 mm, narrowly obovate); and legumes with a beak 3–4 mm long (vs. shortly acuminate).

Etymology. The specific epithet is from the Latin "lustricola," meaning "wilderness dweller."

7. Astragalus lychnobius Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Habahe, ca. 48°02′N, 86°26′E, 730 m, 30 May 2004, *Zhao Yang Chang et al. 2004-427* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo macriculo* Podlech & L. R. Xu stipulis anguste triangularibus, 4–5 mm longis (nec linearibus, 6–8 mm longis), foliolis 8–10-jugis (nec (4–)6–8 jugis), pilis ± medifixis, appressis ad leviter ascendentibus (nec pilis medifixis ascendentibus et pilis basifixis ascendentibus ad patentibus) obtectis, bracteis ca. 2 mm longis (nec 6–10 mm longis), dentibus calycis 1–1.5 mm (nec 2.5–3 mm) longis, vexillo ca. 25 mm (nec 20–21 mm) longo.

Plants 6–8 cm tall, acaulescent or nearly so, loosely caespitose, covered with bifurcate hairs. *Caudex* divided with subterranean stolons 3–6 cm long. *Stems*, if present, up to 1 cm long, very densely covered with strongly asymmetrically bifurcate, ascending to partly spreading, ± flexuose, tangled white hairs 1–1.5 mm long. *Stipules* 4–5 mm long, narrowly triangular, adnate to the petiole for 1–2 mm, rather densely covered with symmetrically to asymmetrically bifurcate, subappressed to slightly ascending white hairs ca. 0.5 mm long, at the margins with basifixed hairs. *Leaves* 3–7 cm long; petiole 1.5–3 cm long, like the rachis densely covered with ± medifixed, subappressed to ascending hairs 0.5–1 mm long and with few, strongly asymmetrically bifurcate, spreading hairs ca. 1 mm long. *Leaflets* in 8–10 pairs, narrowly elliptic to elliptic, 3–8 × 1.5–4 mm, subacute to rounded or minutely retuse, on both sides rather densely to densely (in immature plants) or loosely (in mature plants) covered with ± symmetrically to slightly asymmetrically bifurcate, appressed to slightly ascending hairs 0.8–1.2 mm long. *Racemes* subsessile, 1- to 4-flowered. *Bracts* membranous, whitish, ca. 2 mm long, narrowly triangular, densely white hairy, with some black hairs mixed in. *Pedicels* ca. 1 mm long, white and black hairy. *Calyx* whitish membranous, tubular, obliquely cut at the mouth, 11–12 mm long, densely covered with strongly asymmetrically bifurcate or subbasifixed, tangled, flexuose white hairs 0.5–1 mm long and with more medifixed black hairs, especially toward the teeth, sometimes with 5 blackish longitudinal stripes; teeth narrowly triangular to subulate, 1–1.5 mm long, densely white hairy on inner side. *Petals* whitish or yellow, yellowish when dry. *Standard* ca. 25 mm long; limb ca. 9 mm wide, obovate, widely and deeply emarginate, gradually narrowed into the claw. *Wings* ca. 21 mm long; limbs narrowly obovate, widely obliquely emarginate, ca. 8 × 3 mm; auricle ca. 1 mm long, claw ca. 13 mm long. *Keel* ca. 20 mm long; limbs obliquely elliptic, with widely curved lower edge and slightly concave upper edge, obtuse, ca. 6 × 3 mm; auricle minute, claw ca. 13 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, narrowly oblong, very densely villous, with white, ± spreading hairs; style sparsely hairy at the base. *Legumes* unknown.

Astragalus lychnobius differs from *A. macriculus* by stipules narrowly triangular, 4–5 mm long (vs. linear, 6–8 mm); leaflets in 8 to 10 pairs, with ± medifixed, appressed to slightly ascending hairs (vs. (4 to)6 to 8 pairs, with medifixed, ascending hairs and basifixed, ascending to spreading hairs); bracts ca. 2 mm long

(vs. 6–10 mm); calyx teeth 1–1.5 mm long (vs. 2.5–3 mm); and standard ca. 25 mm long (vs. 20–21 mm).

Etymology. The specific epithet derives from the Greek, and it means "living in the light."

8. Astragalus macriculus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Yumin, ca. 46°12′N, 82°59′E, 974 m, 25 May 2004, *Zhao Yang Chang et al. 2004-343* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo hsinbatico* P. Y. Fu & Y. A. Chen foliis 4–5 cm (nec 8–18 cm) longis, foliolis (4–)6–8-jugis (nec 10–12-jugis), anguste ellipticis, 5–10 × 1.5–3 mm, acute (nec ellipticis ad obovatis, 7–15 × 3–8 mm, obtusis vel emarginatis), utrinque pilis ± medifixis et basifixis 0.8–1 mm longis (nec pilis medifixis tantum 1.5–2 mm longis) obtectis, bracteis 6–10 mm (nec ca. 5 mm) longis, calyce praeter pilis medifixis etiam pilis basifixis instructo.

Plants 6–8 cm tall, caespitose, nearly acaulescent, covered with ascending to spreading, bifurcate hairs. *Caudex* divided with short subterranean branches. *Stems* 1–1.5 cm long, very densely covered with strongly asymmetrically bifurcate, ascending to partly spreading, ± flexuose, tangled white hairs 1–1.5 mm long. *Stipules* greenish, 6–8 mm long, linear, acute, adnate to the petiole for 1–2 mm, loosely hairy like the stem, at the margins with basifixed hairs. *Leaves* 4–5 cm long; petiole 1.5–2 cm long, like the rachis densely covered with ± medifixed, subappressed to ascending hairs 0.5–1 mm long and with few, strongly asymmetrically bifurcate, spreading hairs 1.5–2 mm long. *Leaflets* in (4 to)6 to 8 pairs, narrowly elliptic, 5–10 × 1.5–3 mm, acute, often folded, on both sides rather densely to densely covered with ± medifixed, ascending hairs and with basifixed, ascending to spreading hairs 0.8–1 mm long. *Racemes* subsessile, loosely 4- to 5-flowered. *Bracts* membranous, linear, 6–10 mm long, with subbasifixed white hairs 1–1.5 mm long and shorter black hairs. *Pedicels* 2–3 mm long, white and black hairy. *Calyx* whitish membranous, narrowly tubular, obliquely cut at the mouth, 11–12 mm long, densely covered with symmetrically to strongly asymmetrically, subbasifixed to ascending, flexuose, tangled white and black hairs up to 1 mm long and with ± straight, strongly asymmetrically bifurcate to basifixed, ± spreading hairs up to 2 mm long; teeth narrowly triangular to subulate, 2.5–3 mm long, densely white hairy on inner side. *Petals* whitish or yellow. *Standard* ca. 21 mm; limb ca. 8 mm wide, obovate, emarginate, slightly constricted below the middle, gradually narrowed into the short claw. *Wings* ca. 18 mm long; limbs narrowly elliptic, obtuse, ca. 7 × 3 mm; auricle very short, claw ca. 11 mm long. *Keel* 15–16 mm long; limbs obliquely elliptic, with widely curved lower edge and slightly concave upper edge, subacute, ca. 6 × 3 mm; auricle indistinct, claw 10–11 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely white hairy. *Legumes* unknown.

Astragalus macriculus differs from *A. hsinbaticus* by leaves 4–5 cm long (vs. 8–18 cm); leaflets in (4 to)6 to 8 pairs, narrowly elliptic, 5–10 × 1.5–3 mm, acute, with ± medifixed and basifixed hairs 0.8–1 mm long (vs. in 10 to 12 pairs, elliptic to obovate, 7–15 × 3–8 mm, obtuse or emarginate, with only medifixed hairs 1.5–2 mm); bracts 6–10 mm long (vs. ca. 5 mm); and calyx with medifixed and basifixed hairs (vs. only with medifixed hairs).

Etymology. The specific epithet is from the Latin "macriculus," meaning "slight, thin and small," because of the small size of the plant.

9. Astragalus ningxiaensis Podlech & L. R. Xu, sp. nov. TYPE: China. Ningxia: near Zhongwei, ca. 37°31′N, 105°11′E, 1634 m, 4 May 2005, *Zhao Yang Chang et al. 2004-090* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo levidensi* Podlech & L. R. Xu stipulis 4–5 mm (nec 5–8 mm longis), petiolo per 1–2 mm (nec 3–4 mm) adnatis, pilis maxime asymmetrice bifurcatis ad basifixis (nec symmetrice ad asymmetrice bifurcatis) obtectis, foliolis 6–8-jugis (nec 4–6-jugis), pilis 0.8–1 mm (nec 0.5–0.7 mm) longis instructis, bracteis angustissime triangularibus, 10–11 mm longis (nec anguste ovatis, 7–8 mm longis), calyce 10–12 mm longo cum dentibus 3.5–4 mm longis (nec 7–9 mm longo cum dentibus ca. 2 mm longis), vexillo 23–27 mm (nec 20–21 mm) longo.

Plants 5–7 cm tall, acaulescent, densely caespitose, white hairy. *Caudex* strongly divided, with many short subterranean branches. *Stipules* whitish membranous, 4–5 mm long, triangular, acute, adnate to the petiole for 1–2 mm, densely covered with strongly asymmetrically bifurcate to basifixed hairs 0.3–1 mm long, at the margins with minute sessile glands. *Leaves* 3–6 cm long; petiole 1.5–3 cm long, like the rachis slender, densely covered with ± medifixed, appressed hairs 0.6–0.7 mm long. *Leaflets* in 6 to 8 pairs, narrowly elliptic to elliptic, 3–7 × 1–2 mm, subacute to obtuse, on upper side sparsely to rarely loosely hairy, sometimes only toward the margins, on underside rather densely covered with ± medifixed, appressed hairs 0.8–1 mm long. *Racemes* sessile, 3- to 4-flowered. *Bracts* whitish membranous with greenish tip, 10–11 mm long, very narrowly triangular, covered with ± spreading, basifixed hairs 0.5–0.8 mm long. *Pedicels* 0.5–1 mm long, hairy. *Calyx* whitish with greenish teeth, tubular, 10–12 mm long, densely covered with subbasifixed to basifixed, tangled, ±

spreading hairs up to 1.2 mm long; teeth subulate, 3.5–4 mm long, densely white hairy on inner side. *Petals* purple in life, yellowish when dry. *Standard* 23–27 mm long; limb narrowly obovate, emarginate, gradually narrowed at the base. *Wings* 21–25 mm long; limbs narrowly oblong to slightly dilated toward the obliquely incised tip, 8–10 × 2.5–3 mm; auricle ca. 0.3–0.5 mm long, claw 13–16 mm long. *Keel* 18–20 mm long; limbs obliquely elliptic, with widely curved lower edge and slightly concave upper edge, obtuse, 6–7 × 3–3.5 mm; auricle minute, claw 12–13 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, narrowly oblong, white hairy; style long, glabrous. Legumes unknown.

Astragalus ningxiaensis differs from *A. levidensis* by stipules 4–5 mm long, adnate to the petiole for 1–2 mm, covered with strongly asymmetrically bifurcate to basifixed hairs (vs. 5–8 mm, adnate to the petiole for 3–4 mm, covered with symmetrically to asymmetrically bifurcate hairs); leaflets in 6 to 8 pairs, with hairs 0.8–1 mm long (vs. in 4 to 6 pairs, with hairs 0.5–0.7 mm); bracts very narrowly triangular, 10–11 mm long (vs. narrowly ovate, 4–5 mm); calyx 10–12 mm long with teeth 3.5–4 mm long (vs. 7–9 mm, with teeth ca. 2 mm); and standard 23–27 mm long (vs. 20–21 mm).

Etymology. Astragalus ningxiaensis is named after the Chinese province Ningxia.

Paratype. CHINA. **Ningxia:** near Wuzhong, 1290 m, 3 May 2004, *Zhao-Yang Chang et al. 2004-082* (MSB, WUK).

10. Astragalus occultus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Altai city, ca. 47°50′N, 88°12′E, 790 m, 1 June 2004, *Zhao Yang Chang et al. 2004-470* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo galactite* Pallas, cui ob foliola supra glabra similis, stipulis 4–5 mm longis, dense pilis symmetrice ad asymmetrice bifurcatis obtectis (nec 5–7(–10) mm longis, pilis maxime asymmetrice bifurcatis obtectis), foliolis 2–6 × 0.8–2.5 mm (nec 5–13(–19) × 1–3(–5) mm), bracteis ca. 5 mm (nec 6–9 mm) longis, calyce 6–7 mm longis cum dentibus 1.5–2 mm longis (nec 9 mm longis cum dentibus 4–6 mm longis), pilis subbasifixis ad basifixis (nec asymmetrice bifurcatis) obtecto, vexillo ca. 15–18 mm (nec 21–26 mm) longo.

Plants (including leaves) 5–7 cm tall, acaulescent or nearly so, densely caespitose, covered with white hairs. *Caudex* with a pluricipital root crown, branches very short, covered with blackish bark and remnants of old stipules. *Stems*, if present, very short, up to 0.5 cm long, very densely covered with ± medifixed appressed hairs 0.5–0.7 mm long. *Stipules* whitish hyaline, 4–5 mm long, narrowly triangular to triangular, adnate to the petiole for ca. 2 mm, loosely to rather densely covered with symmetrically to asymmetrically bifurcate, appressed hairs, at the margins with basifixed hairs. *Leaves* ca. 5–7 cm long; petiole 2.5–3 cm long, like the rachis slender, densely to very densely hairy like the stem. *Leaflets* in 7 to 10 pairs, remote, narrowly elliptic, 2–6 × 0.8–2.5 mm, obtuse to subacute, on upper side glabrous or rarely with some hairs toward the margins, on underside rather densely to densely hairy like the rachis. *Racemes* sessile, 1- to 2-flowered. *Bracts* whitish hyaline, narrowly triangular to ovate, acute, ca. 5 mm long, densely covered with strongly asymmetrically bifurcate to basifixed hairs 0.8–1 mm long, at the margins with minute, globular glands. *Pedicels* up to 0.5 mm long, hairy. *Calyx* campanulate, 6–7 mm long, densely covered with ascending, subbasifixed to basifixed hairs 1–1.5 mm long; teeth narrowly triangular to subulate, 1.5–2 mm long, hairy on inner side. *Petals* yellowish or whitish. *Standard* ca. 15–18 mm long; limb elliptic, 5–6 mm wide, emarginate, gradually narrowed into the short, cuneate claw. *Wings* 15–17 mm long; limbs narrowly oblong, slightly obliquely emarginate, 6–7.5 × 2 mm; auricle 0.5 mm long, claw 9–10 mm long. *Keel* 14–15 mm long; limbs narrowly elliptic, ca. 5.5 × 2 mm; auricle indistinct, claw ca. 9 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, narrowly ellipsoid, white hairy; style glabrous. *Legumes* unknown.

Astragalus occultus differs from *A. galactites* by stipules 4–5 mm long with symmetrically to asymmetrically bifurcate hairs (vs. 5–7(–10) mm with strongly asymmetrically bifurcate hairs); leaflets 2–6 × 0.8–2.5 mm (vs. 5–13(–19) × 1–3(–5) mm); bracts ca. 5 mm long (vs. 6–9 mm); calyx 6–7 mm long, covered with subbasifixed to basifixed hairs, with teeth 1.5–2 mm long (vs. 9 mm, covered with asymmetrically bifurcate hairs, with teeth 4–6 mm); and standard ca. 15–18 mm long (vs. 21–26 mm).

Etymology. The specific epithet is from the Latin "occultus," meaning "hidden," because the flowers are hidden within the leaves.

Paratype. CHINA. **Gansu:** Lanzou, 1900 m, 14 June 1996, *Lang-Ran Xu 96-010* (MSB).

11. Astragalus perbrevis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Jeminay, ca. 47°25′N, 85°52′E, 1285 m, 27 May 2004, *Zhao Yang Chang et al. 2004–377* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo jiuquanensi* S. B. Ho stipulis 8–10 mm (nec 3–4 mm) longis, petiolo cum rhachide dense

pilis ± medifixis, flexuosis ca. 1 mm longis et basifixis, rectis, patentibus ad 2 mm longis obtecto (nec pilis ± medifixis 0.4–0.6 mm longis tantum obtecto), foliolis utrinque dense pilis medifixis ascendentibus, ca. 1.5 mm longis (nec supra laxe, subtus densiore pilis medifixis appressis ad 1 mm longis) obtectis, bracteis 8–10 mm (nec 5–6 mm) longis.

Plants 2–3 cm tall, acaulescent, very densely caespitose, densely covered with white hairs. *Caudex* with a pluricipital root crown, with very short branches. *Stipules* whitish membranous, 8–10 mm long, adnate to the petiole for 1–3 mm, the free tips narrowly triangular, densely covered with basifixed, subappressed to slightly ascending hairs up to 2.5 mm long. *Leaves* 1.5–3 cm long; petiole 0.6–1 cm long, like the rachis densely covered with ± medifixed, flexuose, subappressed to ascending hairs ca. 1 mm long and with basifixed, straight, spreading hairs up to 2 mm long. *Leaflets* in 1 to 3 pairs, narrowly elliptic, 5–10 × 2–3.5 mm, subacute, on both sides densely covered with medifixed, ascending hairs ca. 1.5 mm long. *Racemes* sessile, few-flowered. *Bracts* whitish hyaline, narrowly triangular, 8–10 mm long, rather densely covered with basifixed hairs ca. 1 mm long. *Flowers* sessile. *Petals* whitish yellow when dry. *Calyx* ca. 12 mm long, densely covered with symmetrically to asymmetrically bifurcate, flexuose, subappressed to ascending hairs ca. 1 mm long and with basifixed, straight, ascending to nearly spreading hairs 2–3 mm long; teeth narrowly triangular, ca. 3 mm long, hairy on inner side. *Standard* ca. 25 mm long; limb ca. 9 mm wide, obovate, deeply emarginate, angularly passing into the cuneate claw. *Wings* ca. 22 mm long; limbs narrowly obovate, deeply emarginate to obliquely bilobed, 9 × 3.5 mm; auricle 1 mm long, claw ca. 13 mm long. *Keel* ca. 21 mm long; limbs obliquely obovate, with widely curved lower edge and ± straight upper edge, obtuse, ca. 7 × 3.5 mm; auricle ca. 0.8 mm long, claw ca. 14 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely white hairy. *Legumes* unknown.

Astragalus perbrevis differs from *A. jiuquanensis* by stipules 8–10 mm long (vs. 3–4 mm); petiole and rachis densely covered with ± medifixed, flexuose hairs ca. 1 mm long and with basifixed, straight, spreading hairs up to 2 mm long (vs. only with ± medifixed hairs 0.4–0.6 mm); leaflets on both sides with medifixed, ascending hairs ca. 1.5 mm long (vs. on upper side loosely, on underside more densely covered with appressed hairs up to 1 mm); and bracts 8–10 mm long (vs. 5–6 mm).

Etymology. The specific epithet is from the Latin "perbrevis," meaning "very short."

12. Astragalus porphyreus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: Berler, ca. 44°N, 83°E, 2091 m, 21 May 2004, *Zhao-Yang Chang et al. 2004-302* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo vesco* Podlech & L. R. Xu stipulis pilis basifixis (nec symmetrice ad asymmetrice bifurcatis) obtectis, foliolis 1–2-jugis (nec 2–3-jugis), pilis 0.3–0.5 mm (nec ad 1 mm) longis instructis, calyce pilis basifixis patentibus (nec pilis medifixis appressis) obtecto, petalis purpureis (nec albis et rubro-suffusis), vexillo ca. 16–17 mm longo, oblongo, emarginato, infra medium constricto, basi angulari-auriculato (nec ca. 19 mm longo, obovato, rotundato, basi gradatim angustato).

Plants 2–4 cm tall, acaulescent, densely caespitose, only white hairy. *Caudex* with a pluricipital root crown. *Stipules* whitish membranous, 5–6 mm long, triangular, adnate to the petiole for ca. 3 mm, loosely to rather densely covered with basifixed, subappressed hairs up to 1 mm long. *Leaves* 0.8–1.5 cm long; petiole 0.3–0.7 cm long, like the rachis slender, very densely covered with medifixed, appressed hairs 0.4–0.6 mm long. *Leaflets* in 1 to 2 pairs, obovate, 3–6 × 1.2–3 mm, subacute to shortly acuminate, mostly boot-shaped or folded, especially toward the tip, covered on upper side loosely to rather densely, on underside more densely with appressed, medifixed hairs 0.3–0.5 mm long. *Racemes* sessile, 1- to 2-flowered. *Bracts* whitish membranous, very narrowly triangular, ca. 3 mm long, with basifixed hairs 0.5–1 mm long. *Flowers* sessile. *Calyx* campanulate-tubular, 8–9 mm long, rather densely to densely covered with subbasifixed to basifixed, spreading, tangled hairs 0.5–1 mm long; teeth subulate, 2–2.5 mm long. *Petals* purplish in life, whitish or yellowish when dry. *Standard* ca. 16–17 mm long; limb oblong, 4.5–5.5 mm wide, emarginate, below the middle constricted, at the base angular-auriculate, subabruptly contracted into the short claw. *Wings* 14–15 mm long; limbs narrowly oblong, obtuse, ca. 7.5–8 × 2.2 mm; auricle ca. 0.5 mm long, claw ca. 7 mm long. *Keel* ca. 12–13 mm long; limbs obliquely elliptic, with widely curved lower edge and ± straight upper edge, subacute, ca. 5 × 2.2 mm; auricle short. *Ovary* sessile, white hairy; style glabrous. *Legumes* unknown.

Astragalus porphyreus differs from *A. vescus* by stipules with basifixed hairs (vs. symmetrically to asymmetrically bifurcate hairs); leaflets in 1 to 2 pairs, with hairs 0.3–0.5 mm long (vs. in 2 to 3 pairs, with hairs up to 1 mm); calyx with basifixed, spreading hairs (vs. medifixed, appressed hairs); petals purple (vs. whitish, red-suffused); and standard 16–17 mm long, oblong, emarginate, constricted below the middle, at the base angular-auriculate (vs.

ca. 19 mm, obovate, rounded, at the base gradually narrowed).

Etymology. The specific epithet is from the Latin "porphyreus," because of the purplish petals.

Paratypes. CHINA. **Xinjiang:** Berler, 1656 m, 21 May 2004, *Zhao-Yang Chang et al. 2004-299* (MSB, WUK); near Wenquan, 1430 m, 22 May 2004, *Zhao-Yang Chang et al. 2004-313* (MSB, WUK).

13. Astragalus secretus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Burqin, ca. 47°41′N, 86°59′E, 524 m, 1 May 2004, *Zaho-Yang Chang et al. 2004-461* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo vesco* Podlech & L. R. Xu foliolis 5–10 × 1.5–4 mm (nec 2–5 × 0.5–2.2 mm), utrinque densissime pilosis (nec supra laxe, subtus densiore pilosis), racemis pedunculo 2–3 cm longo suffultis, 5–7-floribus (nec sessilibus, 1–2-floribus), bracteis margine tantum ciliatis (nec pilosis), calyce pilis symmetrice ad maxime asymmetrice bifurcatis 0.8–1 mm longis (nec ± medifixis tantum 0.5–0.6 mm longis) obtecto, dentibus anguste triangularibus 1–2 mm longis (nec subulatis, 2–2.5 mm longis), petalis flavis (nec albis, rubro-suffusis), carina ca. 13 mm (nec ca. 16 mm) longa.

Plants 3.5–6 cm tall, acaulescent, caespitose, white hairy. *Caudex* divided with short branches, covered with blackish remnants of old leaves. *Stipules* whitish membranous, ca. 4 mm long, ovate, shortly acuminate, adnate to the petiole for ca. 2 mm, densely covered with ± medifixed, appressed hairs up to 1 mm long, at the margins with basifixed hairs. *Leaves* 2.5–3 cm long; petiole 0.8–2 cm long, like the rachis slender, sulcate adaxially, densely to very densely covered with medifixed, appressed hairs 0.5–0.7 mm long. *Leaflets* in 1 to 3 pairs, obovate, 5–10 × 1.5–4 mm, subacute, on both sides very densely covered with appressed, medifixed hairs 0.8–1.2 mm long. *Racemes* 5- to 7-flowered, with a peduncle 2–3 cm long and hairy like the rachis. *Bracts* whitish membranous, sometimes with slightly greenish tip, ovate or narrowly triangular, 2–4 mm long, at the margins with subbasifixed to basifixed hairs, otherwise glabrous. *Flowers* subsessile. *Calyx* campanulate, 7–8 mm long, densely covered with symmetrically to strongly asymmetrically bifurcate, appressed hairs 0.8–1 mm long; teeth narrowly triangular, 1–2 mm long, white hairy on inner side. *Petals* yellow. *Standard* ca. 17 mm long; limb obovate, ca. 8 mm wide, retuse, gradually narrowed into the widely cuneate, short claw. *Wings* ca. 16 mm long; limbs narrowly obovate, rounded, ca. 9 × 3.5 mm; auricle ca. 0.3–0.4 mm long, claw ca. 7 mm long. *Keel* ca. 13 mm long; limbs obliquely obovate, upper part with nearly rectangularly curved lower edge and ± straight upper edge, subacute, ca. 6 × 3 mm; auricle minute, claw ca. 7 mm long. *Stamen tube* truncate at the mouth. *Ovary* subsessile, white hairy; style glabrous. *Legumes* unknown.

Astragalus secretus differs from *A. vescus* by leaflets 5–10 × 1.5–4 mm, on both sides very densely hairy (vs. 2–5 × 0.5–2.2 mm, on upper side loosely, on underside more densely hairy); racemes with a peduncle 2–3 cm long, 5- to 7-flowered (vs. sessile, 1- to 2-flowered); bracts ciliate only at the margins (vs. hairy all over); calyx with symmetrically to asymmetrically bifurcate hairs 0.8–1 mm long, teeth narrowly triangular, 1–2 mm long (vs. with ± medifixed hairs 0.5–0.6 mm, teeth subulate, 2–2.5 mm); petals yellow (vs. white, red-suffused); and keel ca. 13 mm long (vs. ca. 16 mm).

Etymology. The specific epithet is from the Latin "secretus," meaning "remote," because the plant is found in sparsely inhabited mountain areas.

14. Astragalus sinkiangensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Wenquan, ca. 44°58′N, 81°06′E, 1430 m, 22 May 2004, *Zhao Yang Chang 2004-314* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo geerwusuensi* H. C. Fu plantis acaulescentibus, sine stolonibus subterraneis elongatis (nec subacaulescentibus cum stolonibus subterraneis elongatis et caulibus brevibus sed distinctis), stipulis petiolo per ca. 1 mm (nec 3–5 mm) adnatis, foliolis late obovatis ad suborbicularibus, 4–6 × 3.5–5.5 mm (nec ellipticis, 8–14 × 3–8 mm), racemis 1–2-floribus, sessilibus (nec 7–10-floribus, pedunculo 1–2 cm longo suffultis), vexillo ca. 25 mm longo, oblongo-panduriforme, basia hastato-auriculato (nec 15–20 mm longo, elliptico-obovato).

Plants ca. 8 cm tall, acaulescent, caespitose. *Caudex* strong, with a pluricipital root crown. *Stipules* 10–15 mm long, from a narrowly triangular base long linear-acuminate, adnate to the petiole for ca. 1 mm, loosely covered with basifixed, spreading white hairs 1–2 mm long. *Leaves* 5–8 cm long; petiole 1.5–2 cm long, like the rachis rather densely covered with symmetrically to asymmetrically bifurcate, ± spreading, tangled hairs 0.5–1 mm long and with some basifixed longer hairs up to 2 mm long. *Leaflets* in 7 to 9 pairs, widely obovate to suborbicular, 4–6 × 3.5–5.5 mm, rounded, on upper side sparsely to loosely, on underside rather densely covered with symmetrically to asymmetrically, partly flexuose, ascending to spreading white hairs 0.5–0.8 mm long, with few basifixed straight, longer hairs mixed in. *Racemes* sessile, 1- to 2-flowered. *Bracts* narrowly triangular, 5–7 mm long, hairy like the stipules. *Pedicels* very

short. *Calyx* 10–12 mm long, tubular, densely covered with extremely asymmetrically bifurcate to basifixed, spreading hairs 1–2 mm long; teeth filiform, ca. 4 mm long, hairy on inner side. *Petals* white. *Standard* ca. 25 mm long; limb ca. 8 mm wide, oblong-panduriform, emarginate, in lower 1/3 slightly constricted, at the base widened, hastate-auriculate, widely cuneately passing into the short claw. *Wings* 22–23 mm long; limbs narrowly oblong, obliquely retuse, 10–11 × ca. 2 mm; auricle ca. 0.8 mm long, claw ca. 13 mm long. *Keel* ca. 21 mm long; limbs oblong, slightly curved, obtuse, ca. 7 × 2.5 mm; auricle ca. 0.8 mm long, claw 13 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, ellipsoid, densely white hairy; style long, glabrous. *Legumes* unknown.

Astragalus sinkiangensis differs from *A. geerwusuensis* by being acaulescent, without elongated subterranean stolons (vs. with short but distinct stems and elongated subterranean stolons); stipules adnate to the petiole for 1 mm (vs. for 3–5 mm); leaflets widely obovate to suborbicular, 4–6 × 3.5–5.5 mm (vs. elliptic, 8–14 × 3–8 mm); racemes sessile, 1- to 2-flowered (vs. with a peduncle 1–2 cm, 7- to 10-flowered); and standard ca. 25 mm long, oblong-panduriform, at the base hastate-auriculate (vs. 15–20 mm, elliptic-obovate).

Etymology. Astragalus sinkiangensis is named after Sinkiang, an earlier name for Xinjiang province, China.

15. Astragalus tesquorum Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Tianshan, ca. 43°10′N, 88°36′E, 1540 m, 8 May 2004, *Zhao Yang Chang et al. 2004-124* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo macriculo* Podlech & L. R. Xu mere albo-pilosus (nec bracteis calyceque pilis nigris immixtis), foliolis 4(–5)-jugis (nec (4–)6–8)-jugis), pilis ± medifixis, ascendentibus ad patentibus 1.5–2.5 mm longis (nec pilis partim basifixis 0.8–1 mm longis) obtectis, calyce ca. 8 mm (nec 11–12 mm) longo, dentibus 2 mm (nec 2.5–3 mm) longis, vexillo ca. 17 mm (nec ca. 21 mm) longo.

Plants 3–5 cm tall, acaulescent, densely caespitose, covered with ascending to spreading, bifurcate, white hairs. *Caudex* divided with very short subterranean branches. *Stipules* whitish membranous, 4–8 mm long, linear, acute, adnate to the petiole for ca. 1 mm, rather densely covered with basifixed, ascending hairs 0.5–0.8 mm long. *Leaves* 2–5 cm long; petiole 1–2.5 cm long, like the rachis rather densely covered with symmetrically to strongly asymmetrically, ascending to spreading, ± flexuose, tangled hairs 1–1.8 mm long. *Leaflets* in 4(to 5) pairs, elliptic to obovate, 3–7 × 1.5–4 mm, acute to obtuse, often folded, on both sides rather densely covered with ± medifixed, ascending to partly ± spreading hairs 1.5–2.5 mm long. *Racemes* subsessile, ca. 3-flowered. *Bracts* whitish membranous, linear, 7–8 mm long, hairy like the stipules. *Calyx* whitish membranous, narrowly tubular, obliquely cut at the mouth, ca. 8 mm long, rather densely covered symmetrically to strongly asymmetrically bifurcate or partly basifixed, ascending to spreading hairs up to 1.2 mm long; teeth narrowly triangular to subulate, ca. 2 mm long, densely white hairy on inner side. *Petals* in life purplish, yellowish when dry. *Standard* ca. 17 mm long; limb ca. 7 mm wide, obovate, emarginate, distinctly constricted below the middle, angularly passing into the short claw. *Wings* ca. 17 mm long; limbs narrowly oblong, minutely obliquely incised, ca. 7.5 × 2 mm; auricle ca. 0.5 mm long, claw ca. 9 mm long. *Keel* ca. 15 mm long; limbs obliquely obovate, upper part with widely curved lower edge and slightly concave upper edge, subobtuse, ca. 6 × 3 mm; auricle 0.3 mm long, claw 9 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely white hairy; style glabrous. *Legumes* unknown.

Astragalus tesquorum differs from *A. macriculus* by being white hairy (vs. bracts and calyx being white and black hairy); by leaflets in 4(to 5) pairs, with ± medifixed, ascending to spreading hairs 1.5–2.5 mm long (vs. in (4 to)6 to 8 pairs, with partly basifixed hairs 0.8–1 mm); calyx ca. 8 mm long, with teeth ca. 2 mm long (vs. 11–12 mm, with teeth 2.5–3 mm); and standard ca. 17 mm long (vs. 20–21 mm).

Etymology. The specific epithet is from the Latin "tesquorum," because the species is found in barren wasteland.

16. Astragalus transecticola Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: Berler, ca. 44°N, 83°E, 2090 m, 21 May 2004, *Zhao Yang Chang et al. 2004-303* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo macriculo* Podlech & L. R. Xu pilis mere albis obsitus (nec in bracteis, pedicellis calyceque pilis nigris immixtis), stipulis 10–15 mm (nec 6–8 mm) longis, foliolis ellipticis ad late ellipticis, 3–4 × 2–2.5 mm, rotundatis (nec anguste ellipticis, 5–10 × 1.5–3 mm, acutis), floribus subsessilibus (nec pedicello 2–3 mm longo suffultis), vexillo elliptico (nec obovato, infra medium leviter constricto).

Plants 3–5 cm tall, acaulescent, caespitose, densely covered with ascending to spreading, bifurcate, white hairs. *Caudex* divided with short subterranean branches. *Stipules* whitish membranous, 10–15 mm

long, linear-acute or from ovate base long-acuminate, adnate to the petiole for ca. 3 mm, with spreading, basifixed hairs 1–2 mm long. *Leaves* 2–4.5 cm long; petiole 0.6–1.5 cm long, like the rachis densely covered with symmetrically to asymmetrically bifurcate or basifixed, subappressed to spreading, tangled hairs 0.8–1.5 mm long. *Leaflets* in 6 to 7 pairs, elliptic to widely elliptic, 3–4 × 2–2.5 mm, rounded, on both sides densely covered with asymmetrically to strongly asymmetrically bifurcate, ascending to partly spreading, tangled hairs 0.8–1 mm long. *Racemes* subsessile, ca. 2-flowered. *Bracts* whitish membranous, linear, acute, 10–12 mm long, with basifixed hairs ca. 1 mm long. *Flowers* subsessile. *Calyx* whitish membranous, tubular, obliquely cut at the mouth, 12–13 mm long, densely covered with symmetrically to asymmetrically bifurcate, flexuose, tangled hairs 0.5–1 mm long and with basifixed, ± spreading, straight hairs up to 2 mm long; teeth subulate, 3–4 mm long, densely white hairy on inner side. *Petals* whitish or yellow. *Standard* ca. 21 mm long; limb ca. 8 mm wide, elliptic, emarginate, gradually narrowed into the rather long claw. *Wings* 19–20 mm long; limbs narrowly oblong, distinctly obliquely emarginate, ca. 9 × 2.5 mm; auricle ca. 1 mm long, claw ca. 11 mm long. *Keel* ca. 17 mm long; limbs narrowly elliptic, with widely curved lower and upper edge, subacute, ca. 6 × 2.5 mm; auricle indistinct, claw 10–11 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely white hairy. *Legumes* unknown.

Astragalus transecticola differs from *A. macriculus* by being white hairy (vs. bracts and calyx being white and black hairy); stipules 10–15 mm long (vs. 6–8 mm); leaflets elliptic to widely elliptic, 3–4 × 2–2.5 mm, rounded (vs. narrowly elliptic, 5–10 × 1.5–3 mm, acute); flowers subsessile (vs. with pedicel 2–3 mm); and standard elliptic (vs. obovate, slightly constricted below the middle).

Etymology. The specific epithet is from the Latin "transecticola," meaning an inhabitant of a transect, because the plant is found in many places, including remote regions without main roads.

17. Astragalus trijugus Podlech & L. R. Xu, sp. nov. TYPE: China. Hebei: near Neiqiu City, ca. 37°18′N, 114°31′E, 21 Apr. 1951, *S. Y. Liou 044* (holotype, PE).

Differt ab *Astragalo gregorii* B. Fedtschenko & Basilevskaja plantis caulescentibus, caulibus 1.5–3 cm longis (nec acaulescentibus), foliolis trijugis, ellipticis, 3–8 × 1.5–4 mm (nec unijugis, anguste ellipticis, 3–10 × 1.5 mm), calyce albo-piloso (nec nigro-piloso), vexillo ca. 16 mm (nec 21 mm) longo, ovariis sessilibus (nec stipite ca. 2 mm longo suffultis).

Plants 6–7 cm tall, shortly caulescent, caespitose, with ± medifixed, appressed white hairs. *Caudex* with a pluricipital root crown. *Stems* many, procumbent to ascending, 1.5–3 cm long, very densely covered with hairs 0.8–1 mm long. *Stipules* membranous or with greenish tip, 2.5–4 mm long, triangular-acuminate, adnate to the petiole for 1–1.5 mm, densely hairy like the stem. *Leaves* 2–5 cm long; petiole 1–3 cm long, with the rachis slender, densely hairy like the stem. *Leaflets* in 3 pairs, elliptic, 3–8 × 1.5–4 mm, obtuse to rounded, on both sides loosely to densely covered with hairs 0.6–0.8 mm long. *Peduncles* 1–3 cm long, loosely to densely hairy like the stem. *Racemes* 2- to 4-flowered. *Bracts* membranous, 1–1.5 mm long, ovate, hairy, at the margins also with basifixed hairs. *Pedicels* ca. 0.5 mm long, hairy. *Calyx* 8–9 mm long, tubular, slightly obliquely cut at the mouth, densely hairy like the stem; teeth subulate, ca. 2 mm long, white hairy on inner side. *Petals* yellow when dry. *Standard* ca. 16 mm long; limb ca. 8 mm wide, obovate, widely emarginate, gradually cuneately narrowed at the base. *Wings* ca. 14 mm long; limbs narrowly obovate, obliquely incised, ca. 9 × 3 mm; auricle minute, claw 5–6 mm long. *Keel* ca. 11 mm long; limbs obliquely obovate, upper part with widely curved lower edge and slightly concave upper edge, acute, ca. 4.5 × 2.5 mm; auricle minute, claw ca. 5 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, narrowly oblong, sparsely white hairy; style glabrous. *Legumes* unknown.

Astragalus trijugus differs from *A. gregorii* by stems 1.5–3 cm long (vs. plants acaulescent); leaflets in 3 pairs, elliptic, 3–8 × 1.5–4 mm (vs. in 1 pair, narrowly elliptic, 3–10 × 1.5 mm); calyx white and black hairy (vs. only black hairy); standard ca. 16 mm long (vs. 21 mm); and ovary sessile (vs. with a stipe ca. 2 mm).

Etymology. The specific epithet is from the Latin "trijugus," because the species has three pairs of leaflets.

18. Astragalus vescus Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: Balikun, ca. 44°N, 93°E, 1632 m, 8 May 2004, *Zhao Yang Chang et al. 2004-127* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo parvicarinato* S. B. Ho stipulis 4–5 mm (nec 7–12 mm) longis, petiolo per 1–1.5 mm (nec per 4–6 mm) adnatis, bracteis ca. 3 mm (nec 6–7 mm) longis, calyce pilis ± medifixis appressis (nec basifixis, ± patentibus) obtecto, carina ca. 16 mm (nec 10 mm) longa.

Plants 2–3 cm tall, acaulescent, caespitose, white hairy. *Caudex* divided with short branches. *Stipules* whitish sometimes with greenish tip, 4–5 mm long, narrowly triangular, adnate to the petiole for 1–1.5 mm, loosely to rather densely covered with symmetrically to asymmetrically bifurcate, appressed hairs up to 1 mm long, at the margins with basifixed hairs and minute glands. *Leaves* 1.5–2 cm long; petiole 0.5–1.2 cm long, like the rachis slender, rather densely to densely covered with medifixed, appressed hairs 0.3–0.5 mm long. *Leaflets* in 2 to 3 pairs, obovate, 2–5 × 0.5–2.2 mm, obtuse, covered on upper side loosely, on underside more densely with appressed, medifixed hairs up to 1 mm long. *Racemes* sessile, 1- to 2-flowered. *Bracts* whitish membranous, ovate, ca. 3 mm long, hairy, at the margins with basifixed hairs and minute glands. *Flowers* sessile. *Calyx* campanulate-tubular, 8–9 mm long, rather densely to densely covered with ± medifixed, appressed hairs 0.5–0.6 mm long; teeth subulate, 2–2.5 mm long. *Petals* white, sometimes suffused with red. *Standard* ca. 19 mm long; limb obovate, ca. 8 mm wide, rounded, gradually narrowed at the base. *Wings* ca. 18 mm long; limbs narrowly obovate, rounded, ca. 9 × 3 mm; auricle ca. 0.7 mm long, claw ca. 9 mm long. *Keel* ca. 16 mm long; limbs obliquely elliptic, with widely curved lower edge and slightly concave to straight upper edge, obtuse, ca. 7 × 3 mm; auricle minute. *Ovary* sessile, white hairy; style glabrous. *Legumes* unknown.

Astragalus vescus differs from *A. parvicarinatus* by stipules 4–5 mm long, adnate to the petiole for 1–1.5 mm (vs. 7–12 mm, adnate to the petiole for 4–6 mm); bracts ca. 3 mm long (vs. 6–7 mm); calyx with ± medifixed, appressed hairs (vs. basifixed, ± spreading hairs); and keel ca. 16 mm long (vs. 10 mm).

Etymology. The specific epithet is from the Latin "vescus," meaning "thin, weak," because the plant is very small in size.

Paratypes. CHINA. **Xinjiang:** Balikun, 2089 m, 6 June 2004, *Zhao Yang Chang et al. 2004-510* (MSB, WUK); near Tianshan, 1540 m, *Zhao Yang Chang et al. 2004-125* (MSB, WUK).

19. Astragalus visibilis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Burqin, ca. 47°41′N, 86°59′E, 506 m, 29 May 2004, *C. Y. Chang et al. 2004-405* (holotype, WUK; isotype, MSB).

Differt ab *Astragalo gregorii* B. Fedtschenko & Basilevskaja foliolis 10–18 × 3–8 mm (nec 3–10 × 1.5 mm), racemis pedunculo 2–5 cm (nec 1–2 cm) longo suffultis, 8–10-floribus (nec 2–4-floribus), calyce albi-piloso (nec pilis nigris, paucis albis immixtis obtecto), vexillo ca. 14 mm (nec ca. 21 mm) longo, ovario sessile (nec stipite ca. 2 mm longo suffulto).

Plants 4–7 cm tall, acaulescent, with ± medifixed, appressed, white hairs 0.8–1 mm long. *Caudex* up to 8 mm thick, covered with black bark, with a pluricipital root crown. *Stipules* whitish membranous, 3–4 mm long, triangular, adnate to the petiole for 1–2 mm, densely hairy, at the margins also with basifixed hairs. *Leaves* 2–5 cm long; petiole 1–2.5 cm long, very densely hairy. *Leaflets* in the basal leaves singular, in the following leaves 3, close together, elliptic to obovate or partly narrowly obovate, 10–18 × 3–8 mm, subacute, on both sides very densely hairy. *Peduncles* 2–5 cm long, very densely hairy. *Racemes* densely 8- to 10-flowered. *Bracts* whitish membranous, 1.5–2 mm long, ovate, loosely hairy, at the margins with basifixed hairs and with minute glands. *Calyx* 5–7 mm long, campanulate-tubular, densely white hairy; teeth subulate, 2–3 mm long, densely white hairy on inner side. *Petals* pink. *Standard* ca. 14 mm long, ca. 8 mm wide, slightly emarginate, slightly constricted in lower 1/3, gradually narrowed at the base without distinct claw. *Wings* ca. 12 mm long; limbs narrowly obovate, rounded, 7.5 × 3 mm; auricle ca. 0.5 mm long, claw ca. 4.5 mm long. *Keel* ca. 10 mm long; limbs elliptic, subobtuse, 5 × 3 mm; auricle ca. 0.3 mm long, claw 4.5 mm long. *Stamen tube* truncate at the mouth. *Ovary* sessile, densely white hairy; style hairy. *Legumes* unknown.

Astragalus visibilis differs from *A. gregorii* by leaflets 10–18 × 3–8 mm (vs. 3–10 × 1.5 mm); racemes with a peduncle 2–5 cm long, 8- to 10-flowered (vs. with peduncle 1–2 cm, 2- to 4-flowered); calyx white hairy (vs. predominantly black hairy); standard ca. 14 mm long (vs. ca. 21 mm); and ovary sessile (vs. with a stipe ca. 2 mm).

Etymology. The specific epithet is from the Latin "visibilis," meaning "visible."

XVII. Astragalus sect. **Uliginosi** A. Gray, Proc. Amer. Acad. 6: 196. 1864. TYPE: *Astragalus uliginosus* L.

1. Astragalus qitaiensis Podlech & L. R. Xu, sp. nov. TYPE: China. Xinjiang: near Qitai City, ca. 44°01′N, 89°32′E, 1700 m, 28 Sep. 1957, *K. J. Guan 5221* (holotype, PE).

Differt ab *Astragalo uliginoso* L. caulibus 5–10 cm (nec 30–70 cm) longis, stipulis pilis 0.2–0.5 mm (nec 0.6–0.8 mm) longis obtectis, foliolis ellipticis, 10–25 × 5–12 mm, utrinque sparse pilosis (nec anguste ellipticis, 20–40

× 5–15 mm, supra glabris, subtus laxe pilosis), pedunculis subglabris (nec laxe ad densiuscule pilosis), dentibus calycis 4–5 mm (nec 1.5–3 mm) longis, leguminibus incomplete bilocularibus, septo angusto, ± dense nigro-pilosis (nec glabris).

Plants ca. 30 cm tall, covered with ± medifixed, appressed hairs. *Caudex* branched, with short aerial branches. *Stems* of the current year 5–10 cm long, angular-sulcate, sparsely to loosely covered with white hairs 0.3–0.5 mm long, at the nodes sometimes with black hairs mixed in. *Stipules* whitish membranous, 7–15 mm long, acuminate, highly vaginate-connate behind the stem, loosely to rather densely covered with symmetrically to asymmetrically bifurcate white hairs 0.2–0.5 mm long. *Leaves* 10–12 cm long; petiole 3–4 cm long, with the rachis sulcate adaxially, sparsely to loosely white hairy like the stem. *Leaflets* in 9 to 10 pairs, elliptic, 10–25 × 5–12 mm, rounded to slightly retuse, on both sides sparsely covered with white hairs 0.3–0.5 mm long. *Peduncles* 8–10 cm long, angular-sulcate, subglabrous. *Racemes* ca. 4 cm long, densely many-flowered. *Bracts* hyaline-membranous, 4–5 mm long, narrowly triangular, sparsely black ciliate, at the margins with minute glands. *Pedicels* ca. 1 mm long, black hairy. *Calyx* 9–10 mm long, campanulate, loosely covered with medifixed, appressed black hairs 0.2–0.4 mm long and with symmetrically to asymmetrically bifurcate white hairs 0.5–0.7 mm long; teeth subulate, 4–5 mm long. *Petals* pale greenish yellow. *Standard* 15–16 mm long; limb ca. 5 mm wide, elliptic, emarginate, gradually narrowed at the base. *Wings* ca. 14 mm long; limbs narrowly oblong, obtuse, ca. 5 × 1 mm; auricle ca. 0.5 mm long, claw ca. 9 mm long. *Keel* ca. 13 mm long; limbs obliquely obovate, with widely curved lower and nearly straight upper edge, subacute, ca. 5 × 1.5 mm; auricle minute, claw ca. 8 mm long. *Stamen tube* obliquely cut at the mouth. *Ovary* sessile, hairy. *Legumes* sessile, obliquely erect, narrowly oblong, ca. 10 mm long, ca. 3 mm high and wide, keeled ventrally, ± grooved dorsally, with a beak 1–2 mm long, incompletely bilocular with a narrow septum; valves thinly coriaceous, densely covered with symmetrically to asymmetrically bifurcate, subappressed to slightly ascending, ± flexuose black hairs 0.2–1 mm long, partly glabrescent with age. *Seeds* 1.5–2.5 mm, reddish brown, smooth.

Astragalus qitaiensis differs from *A. uliginosus* by stems 5–10 cm long (vs. 30–70 cm); leaflets elliptic, 10–25 × 5–12 mm, on both sides sparsely hairy (vs. narrowly elliptic, 20–40 × 5–15 mm, on upper side glabrous, on underside loosely hairy); peduncles subglabrous (vs. loosely to rather densely hairy); calyx teeth 4–5 mm long (vs. 1.5–3 mm); and legumes incompletely bilocular with narrow septum, ± densely black hairy (vs. completely bilocular, glabrous).

Etymology. *Astragalus qitaiensis* is named after Qitai City in Xinjiang.

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Additions to the Genus *Pseudopiptocarpha* (Asteraceae, Vernonieae) from Northern South America

Harold Robinson
Department of Botany, National Museum of Natural History, MRC-166, P.O. Box 37012, Smithsonian Institution, Washington, D.C. 20013-7012, U.S.A. robinsoh@si.edu

Sterling C. Keeley
Department of Botany, University of Hawaii, Manoa, 3190 Maile Way, #101, Honolulu, Hawaii, 96822-2279, U.S.A. sterling@hawaii.edu

Abstract. *Pseudopiptocarpha garcia-barrigae* H. Robinson & S. C. Keeley is described as new, and *P. tovarensis* (Gleason) H. Robinson & S. C. Keeley of Venezuela (Asteraceae, Vernonieae) is transferred from *Lepidaploa* (Cassini) Cassini. The new species and *P. tovarensis* have branching inflorescences unlike the two previously known members of *Pseudopiptocarpha* H. Robinson. All four species of *Pseudopiptocarpha* have *Aynia* H. Robinson–type pollen, which does not occur in *Lepidaploa* as redelimited.

Resumen. Se describe *Pseudopiptocarpha garcia-barrigae* H. Robinson & S. C. Keeley como una nueva especie y se transfiere *P. tovarensis* (Gleason) H. Robinson & S. C. Keeley (Asteraceae, Vernonieae) desde *Lepidaploa* (Cassini) Cassini. Ambas especies tienen inflorescencias ramificadas, a diferencia de las que presentan las otras dos especies conocidas para el género *Pseudopiptocarpha* H. Robinson. Las cuatro especies de *Pseudopiptocarpha* tienen polen tipo *Aynia* H. Robinson, el cual no se encuentra en *Lepidaploa* de acuerdo a su nueva circunscripción.

Key words: Asteraceae, Colombia, *Lepidaploa*, *Pseudopiptocarpha*, Venezuela, Vernonieae.

The genus *Pseudopiptocarpha* H. Robinson (Asteraceae, Vernonieae) was described in 1994 for two Colombian species that were previously placed in *Vernonia* Schreber and *Piptocarpha* R. Brown (Robinson, 1994). The two species, *P. elaeagnoides* (Kunth) H. Robinson and *P. schultzii* (H. Karsten ex Schultz-Bipontius) H. Robinson, had long-armed T-shaped trichomes, spiciform inflorescences with heads sessile in axillary clusters, somewhat deciduous inner involucral bracts, short raphids in the achene walls, and a distinctive *Aynia* H. Robinson–type pollen. The two species differed from the related *Lepidaploa* (Cassini) Cassini, which had a branching inflorescence, persistent inner involucral bracts, and elongate raphids in the achene. The two species initially placed in *Pseudopiptocarpha* differed further from most of *Lepidaploa* by the T-shaped trichomes and the specialized pollen. Examination of new collections now leads to a partial emendation of the concept of *Pseudopiptocarpha*.

Among the many collections of the junior author in 1983 and 1984 in northern South America was material initially determined as *Lepidaploa tovarensis* (Gleason) H. Robinson. The species was particularly noted because of its *Aynia*-type pollen, a feature cited by Robinson (1990) in a review of *Lepidaploa* and again at the time of the description of *Pseudopiptocarpha*. At the time of the earlier citations, the significance of the pollen was not fully appreciated. The transfer of *L. tovarensis* from *Lepidaploa* and the description of the related Colombian species result in a concept of *Pseudopiptocarpha* more consistently defined by its pollen.

The *Aynia*-type pollen found in *Pseudopiptocarpha* (Figs. 1, 2) is characterized as tricolporate, echinolophate, with a triplet of lacunae at the poles aligned with the intercolpi rather than the colpi, and with abutting, but incompletely fused, cross-walls in the short colpi above and below the pores. Although not seen with the SEM in the two species described and transferred here, the 40× lens of the compound microscope shows evidence of well-developed, free-standing bacculae, a feature seen in typical *Pseudopiptocarpha*, but not in *Lepidaploa*.

In the Vernonieae, the *Aynia*-type pollen is characteristic of the genera *Aynia*, *Harleya* S. F. Blake, and *Pseudopiptocarpha*. It is not found in *Lepidaploa* as redelimited. Species remaining in *Lepidaploa* have primarily type C grains with a single polar areole or have colpi meeting at the poles.

In the present study, characters in the following order were seen to demonstrate the relationship of *Lepidaploa tovarensis* and the new species to *Pseudopiptocarpha*: the pollen, the T-shaped trichomes on the

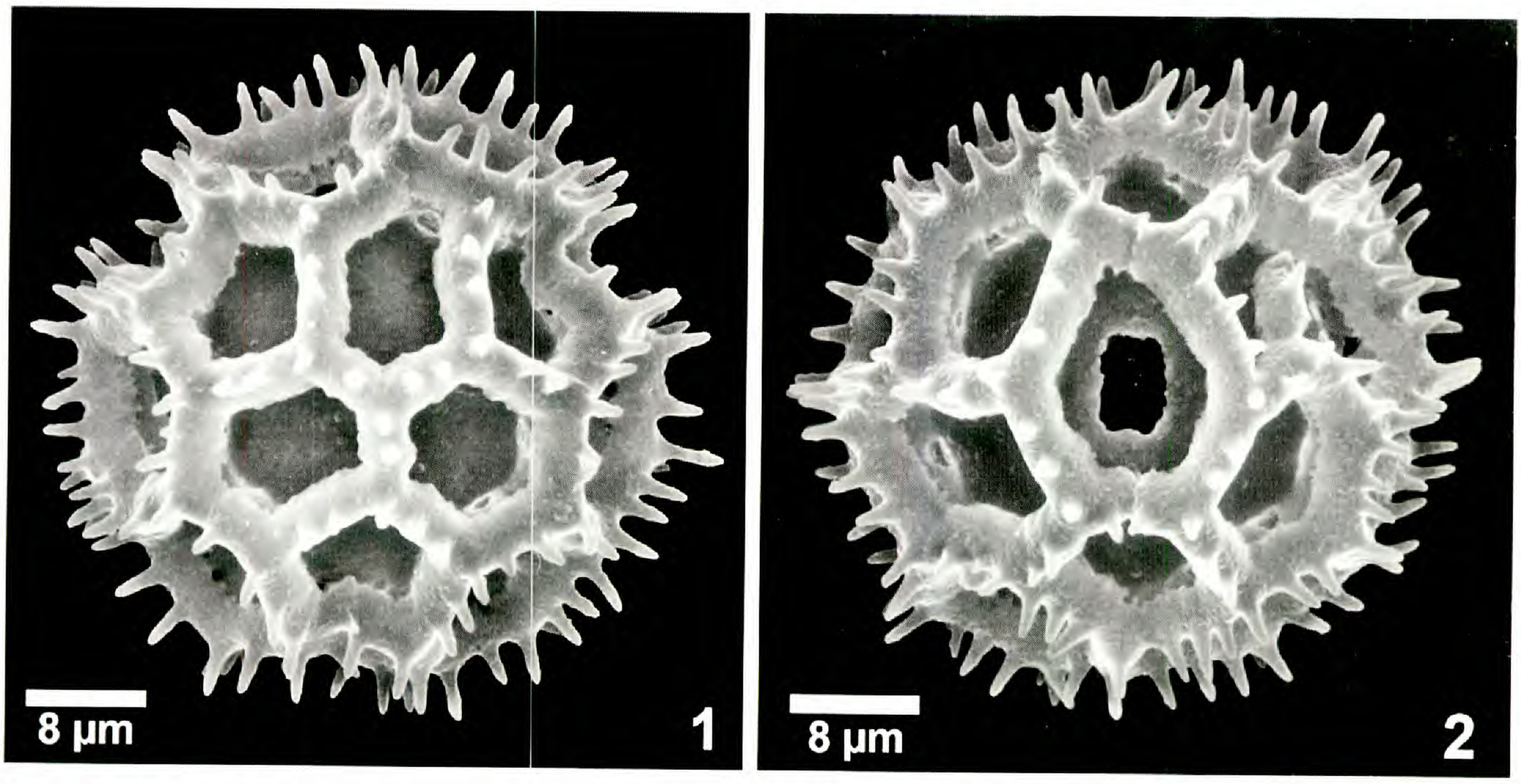

Figure 1, 2. Pollen of *Pseudopiptocarpha tovarensis* (Gleason) H. Robinson & S. C. Keeley. —1. Polar view, showing triplet of lacunae aligned with intercolpi. —2. Colpar view, showing the short colpus not reaching the poles and showing incompletely fused crosswalls above and below pore.

leaf undersurfaces, the tendency for the main axis of the inflorescence to have only axillary clusters of heads, and the tendency of the inner involucral bracts to be deciduous. Raphids seem to be lost or obscured in mature achenes of *P. tovarensis* (Gleason) H. Robinson & S. C. Keeley and the new species, but they were found in a young achene of the new species, and they were short and subquadrate, as in typical *Pseudopiptocarpha*, unlike the elongate form in *Lepidaploa*. Heads clustered at each node are characteristic of all four species of *Pseudopiptocarpha*, differing from the one or two heads at a node in most *Lepidaploa*.

The two additions to *Pseudopiptocarpha* are as follows.

Pseudopiptocarpha garcia-barrigae H. Robinson & S. C. Keeley, sp. nov. TYPE: Colombia. Santander del Norte: carretera de Abrego a La María (Enclave seco); yerba de tallos largos de unos 2 m, inflorescencia de color lila, 1500–2500 m, 22–23 May 1969, *M. García-Barriga & R. Jaramillo Mejía 19914* (holotype, US; isotype, COL not seen). Figure 3.

Haec species *Pseudopiptocarphae tovarensi* (Gleason) H. Robinson & S. C. Keeley in inflorescentiis ramosis et in pilis T-formibus stipitibus elongatis similis sed in foliis ellipticis et denticulatis in bracteis involucri obtusis et tomentellis et in ramis inflorescentiarum numerosis et ascendentibus differt.

Subshrubs ca. 2 m tall, apparently unbranched below inflorescence; stems terete, faintly striate, loosely tomentose with T-shaped trichomes. Leaves alternate, petioles 0.5–1.5 cm; blades elliptical, 12 × 4 cm wide or wider in lower leaves, reduced to 2.5 × 1.2 cm on main axis of inflorescence, with 7 to 9 pairs of secondary veins ascending from costae at ca. 45° angles, bases of blades obtuse, margins denticulate to subentire, slightly recurved, apex short-acute, upper surface densely pilosulous, lower surface loosely grayish tomentose with long-stalked T-shaped trichomes, with cap-cells not aligned. Inflorescence rather columnar, with 2 to 6 sessile heads in lower leaf axils, in upper part with long, ascending, seriate-cymose branches bearing small bracteoles and clusters of sessile or nearly sessile heads at each node. Heads campanulate, 6–7 mm high; involucres ca. 4 × 4 mm, bracts ca. 30 to 35 in ca. 4 series, broadly ovate to oblong-elliptical, 1–4 × 1–1.5 mm, apex obtuse with abrupt sharp apiculus, outside glabrous at base, obscured by dense grayish tomentum distally; receptacle glabrous, alveolate. Flowers 10 to 13 in a head; corollas lilac, ca. 5.5 mm, with scattered glands outside, especially on throat and distally on lobes, few nonglandular trichomes at tips of lobes, basal tube ca. 2.5 mm, throat ca. 1 mm, lobes ca. 2 mm; anther thecae ca. 1.6 mm, spurs ca. 0.8 mm long, apical appendage of anther oblong-ovate, ca. 0.7 × 0.2 mm, with firm-walled cells; style base with annular ring; style branches with acute,

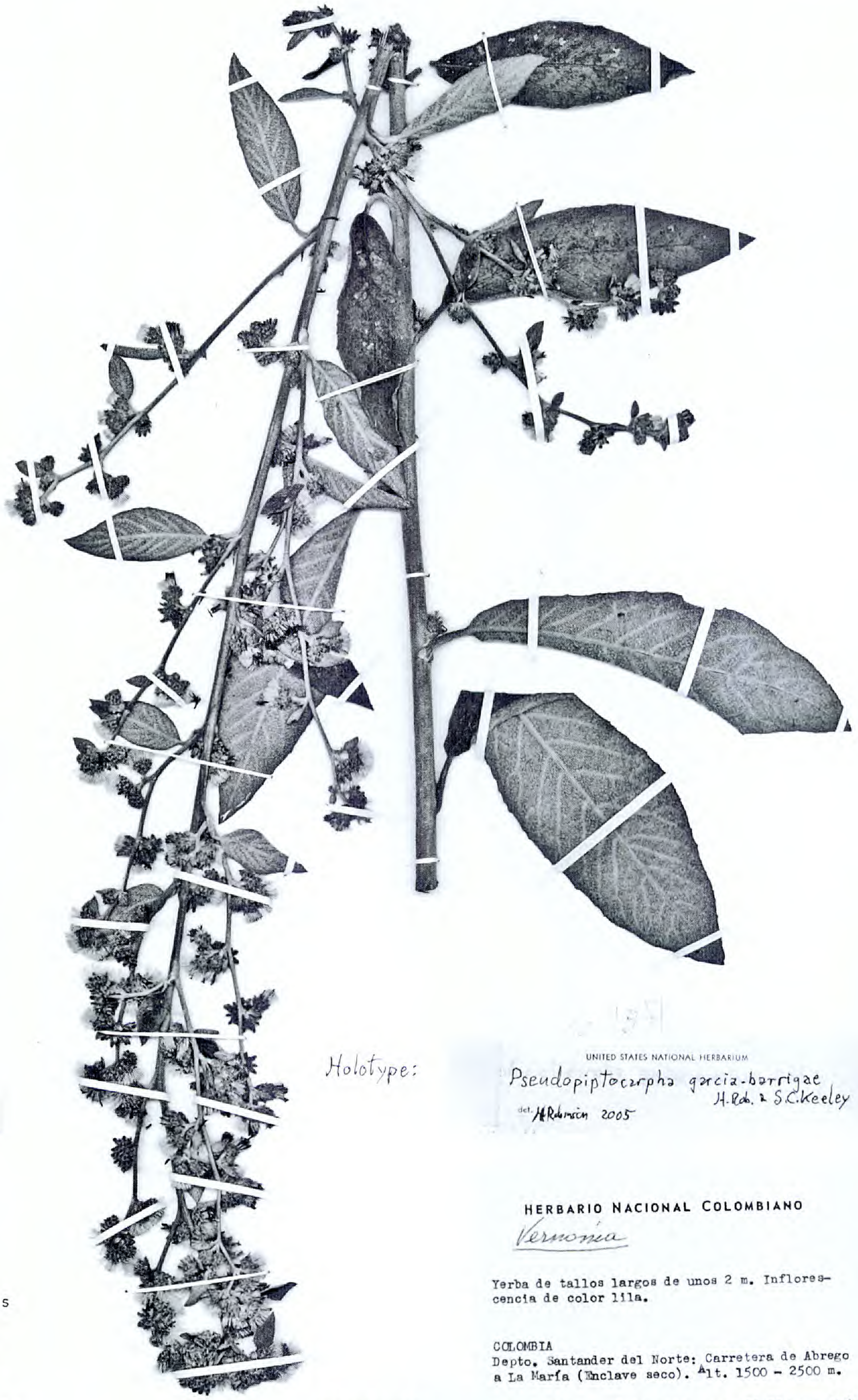

Figure 3. *Pseudopiptocarpha garcia-barrigae* H. Robinson & S. C. Keeley, holotype (US).

sweeping hairs. Achenes cylindrical, 2–2.5 mm, 10-costate, with scattered glandular dots and erect-spreading setulae, short subquadrate raphids seen in young achene; pappus white, outer series of narrow scales ca. 0.5 mm, inner series of 50 to 60 capillary bristles very slender and fragile at base, broader distally. Pollen grains ca. 47 µm diam., echinolophate, *Aynia*-type, with triplet of lacunae

at poles aligned with intercolpi and with medially sutured lophae in the colpi above and below the pores.

Pseudopiptocarpha garcia-barrigae is known only from the type collected in 1969. It is rather fortuitous that the specimen was pulled out of the *Lepidaploa* indet. folder at the time when the new collection of *P. tovarensis* was being studied in 2003. The two species are unquestionably related, sharing the T-shaped trichomes with long, multiseptate stalks and the *Aynia*-type pollen. The cap-cells on the trichomes are more slender in the new species, but in *P. tovarensis* the cap-cells vary from having both ends extended to having one end short. Long-armed T-shaped trichomes are characteristic of typical *Pseudopiptocarpha*, although in the latter the trichomes have shorter stalks, have the cap-cells aligned, and are closely appressed to the stem and leaf surfaces. Such trichomes are in contrast to the more simple forms of trichomes found in most Andean, West Indian, and Central American species of *Lepidaploa*, but well-developed T-shaped trichomes are common in some *Lepidaploa* species, mostly of Brazil (e.g., *L. cotoneaster* (Willdenow ex Sprengel) H. Robinson, *L. rufogrisea* (A. Saint-Hilaire) H. Robinson, and their relatives).

The new species contrasts with *Pseudopiptocarpha tovarensis* by having elliptical rather than oblong-ovate leaves, a more columnar inflorescence with longer, more ascending branches, and much broader, more obtuse, and densely tomentose involucral bracts.

Pseudopiptocarpha tovarensis (Gleason) H. Robinson & S. C. Keeley, comb. nov. Basionym: *Vernonia tovarensis* Gleason, Amer. J. Bot. 19: 753. 1932. *Lepidaploa tovarensis* (Gleason) H. Robinson, Proc. Biol. Soc. Washington 103: 495. 1990. TYPE: Venezuela. Merida: on bushy slopes near Tovar, 1200 m, 31 Jan. 1928, *H. Pittier 12794* (holotype, NY; isotype, US).

The additional specimen, *S. C. Keeley & J. E. Keeley 4480*, agrees closely with the type of Gleason (1932) and with the descriptive information in Badillo (1989), but both the type and the new collection show some details not mentioned in previous descriptions of the species. The trichomes of the stems and lower leaf surfaces form a loose tomentum, with individual trichomes T-shaped and long-stalked. The stalks are multiseptate, and the cap-cells are oriented in all directions with no tendency to appear sericeous. The single cap-cells are long, mounted nearer one end in the type specimen, but extended at both ends and broadened and rather triangular at the juncture with the trichome stalk in the new collection.

The inflorescence in *Pseudopiptocarpha tovarensis* is consistent in form, starting below with clusters of sessile heads in axils of lower foliose bracts, then expanding with branches into a pyramidally thyrsiform shape above. The individual branches appear as seriate cymes with small foliose bracteoles and 2 or 3 or more heads at each node, a pattern also found in some *Lepidaploa*. The involucral bracts are 25 to 30 in ca. 4 series, narrowly ovate to narrowly oblong, 1–4 × 0.5–1 mm. The bract apices are apiculate to shortly aristate, with the arista longer in lower bracts. The bract outer surface is yellowish brown, with a greenish, pilosulous and glanduliferous patch distally near the apex. The innermost bracts are somewhat deciduous, which contrasts with the highly persistent inner bracts of *Lepidaploa*. The receptacle is glabrous, alveolate. Flowers are 6 to 11 in a head. The corollas are without non-glandular trichomes. They have scattered glands below and are densely glanduliferous distally on the lobes.

The spiciform base of the inflorescence in *Pseudopiptocarpha tovarensis* is very similar to that of typical *Pseudopiptocarpha*, but the inflorescence in the original two Colombian species of the genus remains unbranched and spiciform throughout with only axillary clusters of heads.

On the collection label, the question was raised whether the plant was a hybrid. This seems doubtful, but if so, it is one that has persisted in the Tovar area for at least 80 years. Nevertheless, hybridization undoubtedly occurs in many Vernonieae.

Additional specimen examined. VENEZUELA. **Merida:** 4.5 km from Guaraque, on road from Tovar to Canagua, 2.8 km from turnoff to Las Vegas, *S. C. Keeley & J. E. Keeley 4480* (MO, US).

Other specimens seen in the collection at US under the species name are not *Pseudopiptoarpha tovarensis*.

Key to the Four Species of *Pseudopiptocarpha*

1a. Inflorescence spiciform, with all heads clustered in axils of primary leaves; leaf blades subcoriaceous, with upper surface sparsely puberulous and obviously gland-dotted, lower surface sericeous with appressed T-shaped trichomes.
  2a. Leaf blades linear to narrowly lanceolate, 0.6–2 cm wide; secondary veins short, spreading at only 35°–45° angles, arched from near midvein; basal involucral bracts often obscured by pubescence; pappus usually reddish in color . . . . . *P. elaeagnoides* (Kunth) H. Robinson
  2b. Leaf blades elliptical to obovate, 2.3–9.3 cm wide; secondary veins elongate, spreading at 45°–55° angles, straight near midvein; involucral bracts not totally obscured by pubescence; pappus bristles whitish or slight-

ly sordid . . . . . *P. schultzii*
(H. Karsten ex Schultz-Bipontius) H. Robinson

1b. Inflorescence with branches in middle or distal part; leaf blades herbaceous, with upper surface densely pilosulous, lower surface loosely tomentose with long-stalked T-shaped trichomes.
3a. Leaf blades elliptical, widest near middle; inflorescence rather columnar with ascending branches in upper part; involucral bracts broadly ovate to oblong-elliptical with apices obtuse, distally bearing dense grayish tomentum . . . . . *P. garcia-barrigae* H. Robinson & S. C. Keeley
3b. Leaf blades oblong-ovate, widest below middle; inflorescence thrysiform and pyramidal with spreading branches in middle or upper part; involucral bracts narrowly ovate to narrowly oblong, with short-apiculate to aristate apices, with a pilosulous and glanduliferous greenish subapical patch . . . . . *P. tovarensis* (Gleason) H. Robinson & S. C. Keeley

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Verbascum azerbaijanense (Scrophulariaceae), a New Species from Northwest Iran

F. Sharifnia
Department of Biology, Faculty of Science, Islamic Azad University, North Tehran Branch, P.O. Box 19585-936 Tehran, Iran. fa_sharifnia@asia.com

M. Assadi
Institute of Forests and Rangelands, P.O. Box 13185-116, Tehran, Iran

Abstract. *Verbascum azerbaijanense* Sharifnia & Assadi is described and illustrated as a new species. This new species occurs in northwest Iran (Azerbaijan province). It is related to *V. geminiflorum* Hochstetter but is distinguished from it by the length of the inflorescence, the glandular hairs of the calyx, and the absence of fertile bracteoles.

Key words: Biodiversity, *Flora of Iran*, *Verbascum*.

Nearly 60% of ca. 360 species of the genus *Verbascum* L. (Scrophulariaceae) in the world are centered in an area including Turkey (Anatolia) and northwest Iran. The principal center of biodiversity for the genus is located in Anatolia (Huber-Morath, 1978). According to the *Flora Iranica* and other floristic works, 41 species of the genus *Verbascum* occur in Iran (Boissier, 1879; Murbeck, 1925, 1933; Parsa, 1949; Huber-Morath, 1981). Regarding flower morphology, the genus *Verbascum* is related to the genus *Veronica* L. in having similar actinomorphic flowers. Nevertheless, molecular studies of the genus show a closer relationship to *Scrophularia* L. The seed morphology, pubescent filaments, and developed androsperm support DNA analysis results that indicate monophyly of the genus (Olmstead & Reeves, 1995).

One of the authors (F. Sharifnia) revised the genus *Verbascum* for the *Flora of Iran* (Assadi, 1988). The other author, in a plant-collecting excursion to Azerbaijan province, collected an interesting *Verbascum* specimen. Further studies indicated that, even if the specimen is related to *V. geminiflorum* Hochstetter, it is quite distinct from it. In this paper this specimen is described as a new species.

Verbascum azerbaijanense Sharifnia & Assadi, sp. nov. TYPE: Iran. Azerbaijan: 10 km from Jolfa to Poldasht, 39°03′N, 45°35′E, 600 m, *M. Assadi 86771* (holotype, TARI; isotype, TARI). Figure 1.

Planta biennis, 50–60 cm alta, lutescenti-tomentosa, cauli erecto, tereti, folioso, fere jam a basi ramoso. Folia omnia utrinque lutescenti-viridia, pilis stellatis; basalia in petiolum 3–5 cm longum attenuata; lamina oblongo-lanceolata, obtusiuscula, undulata, crenata, 7–10 × 2–4 cm; folia media sessilia, obsolete crenata. Inflorescentia 35–45 cm longa, glomerulis ± dissitis, 1 ad 2 floris; bracteae parvae, ovatae, acuminatae, integerrimae, vix glandulosae; pedicellus 3–5 mm longus, ebracteolatus. Calyx 2–3 mm longus; lobi ovati, subacuti, glandulosi; corolla lutea, 10–15 mm longa, extus stellato-tomentella, intus glabra; stamina 5; filamenta antice ad apicem glabra, ceterum ut postica papillis albidis vel lutescentis; antherae omnes reniformes, medifixae. Capsula elliptica, 5–6 × 2–3 mm, stellato-tomentella.

Biennial, to 50–60 cm high, with persistent adpressed yellowish tomentose trichomes; stems erect, terete, branched from the base. Leaves yellowish green, stellate-tomentose; basal leaves oblong to lanceolate, obtuse, undulate, crenate, 7–10 × 2–4 cm; petiole 3–5 cm; median leaves sessile, crenate. Inflorescence 35–45 cm, branched, broadly paniculate; lax glomerules with 1 to 2 flowers; bracts small, ovate, acuminate, entire, with scattered glands; fertile pedicel 3–5 mm, without bracteoles. Calyx 2–3 mm; lobes ovate, acute, glandular; corolla yellow, 10–15 mm, stellate-tomentose externally, glabrous inside; stamens 5, anthers reniform; filaments with whitish yellow wool, 2 anterior anthers glabrous near the apex, others with white or yellow papillae apically. Capsule elliptic, 5–6 × 2–3 mm, stellate-tomentose.

Distribution and habitat. The new species is endemic to northwest Iran, from Azerbaijan province, and its distribution is rare. It was collected between outcrops of northern slopes of the Aras River. The type locality was mainly an open shrubland, dominated by *Artemisia sieberi* Besser (Asteraceae) and *Stipa* L. species (Poaceae). Other associated species occurring frequently in the area include *Astragalus* L. (Papilionaceae), *Gypsophila bicolor* (Freyn & Sintensis) Grossheim (Caryo-

Figure 1. *Verbascum azerbaijanense* Sharifnia & Assadi. —A. Plant habit. —B. Floral diagram. —C. Capsule. Drawn from the holotype *Assadi 86771* (TARI).

phyllaceae), *Acantholimon karelinii* (Stscheglejew) Bunge (Plumbaginaceae), *Ephedra major* Host (Ephedraceae), *Celtis glabrata* Stevenson (Ulmaceae), and *Agropyrum cristatum* (L.) Gaertner (Poaceae).

Relationships. *Verbascum azerbaijanense* is closely related to *V. geminiflorum*, which is distributed in southeastern Turkey and neighboring Kurdistan (Huber-Morath, 1978, 1981). The two species are contrasted in Table 1.

Acknowledgment. The authors thank E. Moradi, the artist in the Central Herbarium of Iran (TARI), for preparing the illustration.

Table 1. Morphological comparison of *Verbascum geminiflorum* and *V. azerbaijanense*.

Characters	*V. geminiflorum*	*V. azerbaijanense*
Leaf margin	crenate	undulate
Inflorescence length (cm)	15–30	30–45
Flower number per glomerule	(1 to)2 to 4	1 to 2
Fertile bracteoles	2	absent
Glandular trichomes of calyx	absent	present
Corolla length (mm)	20–30	10–15

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Nueva Especie y Cambios Nomenclaturales en *Adesmia* (Leguminosae) de Chile

Emilio A. Ulibarri

Instituto de Botánica Darwinion, Casilla de Correo 22, Labardén 200, B1642HYD San Isidro, Buenos Aires, Argentina. eulibarri@darwin.edu.ar

Resumen. Una nueva especie de Chile, *Adesmia ovallensis* Ulibarri (serie *Argyrophyllae* Burkart), es descripta, ilustrada y comparada con especies vecinas. Se hacen también consideraciones sobre su relación dentro de las series del género *Adesmia* DC. Se establece la sinonimia de *A. kingi* Philippi y *A. sessiliflora* Philippi con *A. argyrophylla* Philippi. Se establece también la lectotipificación de *A. sessiliflora*.

Abstract. A new species from Chile, *Adesmia ovallensis* Ulibarri (series *Argyrophyllae* Burkart), is described, illustrated, and compared with other allied species. Affinities within the series of the genus *Adesmia* DC. are also considered. The synonymy of *A. kingi* Philippi and *A. sessiliflora* Philippi with *A. argyrophylla* Philippi is established. A lectotype for *A. sessiliflora* is also designated.

Key words: *Adesmia*, Chile, conservation, Leguminosae, Pacific coast, Papilionoideae, taxonomy, warm desert.

El estudio de las colecciones de *Adesmia* DC., provenientes de Chile, que se conservan en el Herbario del Instituto Darwinion, permitió detectar un material, dudoso en su identificación cuyo análisis posterior permitió corroborar que se trata de una especie nueva para la ciencia, dentro de este extenso género de ca. 240 especies estrictamente sudamericanas de Leguminosae, Papilionoideae.

Como resultado de este estudio, se planteó la necesidad de revisar las especies de la serie en que se pudo ubicar la nueva especie en cuestión, como también establecer la sinonimia de *Adesmia sessiliflora* Philippi y *A. kingi* Philippi bajo *A. argyrophylla* Philippi. Por consiguiente la serie *Argyrophyllae* Burkart queda integrada por tres especies, todas ellas endémicas de Chile septentrional.

A continuación se describe e ilustra la nueva especie propuesta, comentándose además su relación con las especies afines de la serie *Argyrophyllae* y su posición dentro del género.

Finalmente se tratan las dos especies restantes de la serie *Argyrophyllae* con la sinonimia establecida, el material examinado, las observaciones correspondientes y una clave para su identificación.

1. **Adesmia ovallensis** Ulibarri, sp. nov. TIPO: Chile. IV Región. [Coquimbo]. Ovalle: río Limarí, "arenales del río, lejos del agua, 250 m s. m.", 12 Dec. 1948 (fl, fr), *C. Jiles P. 1121* (holotipo, SI; isotipos, CONC, MO). Figura 1.

Haec species ab affini *Adesmia sessiliflora* Philippi (serie *Argyrophyllae*) distincta: foliolis planis vel subconduplicatis, 2–3(–4) jugis, (2–)5–6(–7) × (1–)1.5–2(–2.5) mm, obovatis, ad apicem emarginatis ad basim cuneatis, glabrescentibus, distantibus; racemis omnibus floriferis et ad apicem spinescentibus; floribus 6–7 mm, pedicellatis, pedicellis 5–8(–11) mm, glabris; calyce campanulato, dentibus brevis, inconspicuis; lomento 1–3-articulato, articulis 3.5–4 × 3.5–4 mm, setis plumosis.

Arbusto de 0.5–1.5 m alt., espinoso; ramas intrincadas, glabras, las juveniles verdosas, las adultas castaño-grisáceas. Hojas de (8–)18–20(–35) mm, glabrescentes, alternas en ramas juveniles, fasciculadas en braquiblastos en las ramas adultas; estípulas deltoides, 0.5–1 mm, pubérulas, ciliadas; folíolos 2–3(–4) pares, obovados, cuneados, emarginados, de (2–)5–6(–7) × (1–)1.5–2 (–2.5) mm, glabrescentes, extendidos a subconduplicados, separados entre sí por 2–6.5 mm de distancia. Racimos floríferos espinescentes; flores de 6–7 mm, dispuestas en la espina central y laterales del sistema espinoso, este divaricado en abanico con 3–4 bifurcaciones; pedicelos de 5–8(–11) mm, glabros, eglandulosos; cáliz campanulado, 1.5–2 mm, 3 mm diám., glabro a cortamente pubérulo externamente, piloso en el interior, dientes muy breves, a veces sólo los 3 abaxiales distinguibles; corola de pétalos amarillos, estandarte anchamente obovado, de 6 × 4.5 mm, glabro o pubérulo en el dorso, uña de 2 mm, vellosa en su cara interna distal; alas largamente subobovadas, de 6 × 2.5 mm, con cilias en su borde adaxial, distal, y algunas entre la lámina y uña, esta de 2.5 mm; quilla incurva, subaguda, de 6–7 × 2–2.5 mm, ciliada en el margen abaxial, uña de 2.5 mm; estambres 10, libres, filiformes, de 7 mm, incurvos, dentro de la quilla; ovario lineal, de 2 mm, 3-ovulado, piloso, estipitado,

Figura 1. *Adesmia ovallensis* Ulibarri. —A. Rama en flor y fruto. —B, C. Folíolos, cara abaxial y adaxial respectivamente. —D. Flor de perfil. —E. Cáliz desplegado. —F. Estandarte, cara interna. —G, H. Alas, cara externa e interna respectivamente. —I. Quilla de perfil. —J. Estambres. —K. Gineceo. —L. Artejos de perfil. —M. Artejo visto desde la sutura placentar. Todo de *Jiles 1121*, holotipo.

estilo incurvo, de 4 mm, estigma terminal, puntiforme. Lomento 1–3 articulado, artejos castaños, de 3.5–4 × 3.5–4 mm con cerdas pilosas, de 6–8 mm. Semillas lenticulares, castañas, de 1.5 × 1.5 mm diám.

Distribución, ecología y conservación. Habita en Chile en la Provincia Biogeográfica del Desierto, un extenso territorio seco y cálido en la costa del Pacífico; el área donde crece *Adesmia ovallensis* pertenece al Distrito Coquimbano, donde predominan los arbustos y roquedales (Cabrera & Willink, 1973). Para más información sobre esta región y principalmente hacia el norte donde las condiciones se hacen más extremas, véase Kalin Arroyo et al. (1988). Especie localizada, tal vez de escasa población con

datos deficientes en lo que respecta a su riesgo global de extinción.

Observaciones. *Adesmia ovallensis* comparte con sus afines la morfología general de arbustos con el sistema espinoso divaricado en abanico y con espinas todas floríferas. Por estos caracteres se la incluye dentro de la serie *Argyrophyllae* (Burkart, 1967) diferenciándose del resto de las especies de esta serie, por ser glabrescente, por poseer escasos pares de folíolos emarginados, flores notablemente pediceladas y dientes del cáliz casi inconspicuos.

Adesmia ovallensis, tiene cierto parecido con *A. argyrophylla* (serie *Argyrophyllae*) de la que se aparta por presentar *A. argyrophylla* fólíolos conduplicados, 3–5 pares, con pubescencia breve, flores subsésiles, con el cáliz piloso externamente y lóbulos aleznados más largos o iguales que el tubo.

Adesmia ovallensis posee también cierto parecido con especies de otras series con las que podría confundirse, ellas son: *A. pauciflora* Vogel (serie *Microphyllae* Burkart), de la que se diferencia porque esta tiene 4–5 folíolos obovado-elípticos, con lóbulos del cáliz agudos y tan largos como el tubo; de *A. peraltae* (Philippi ex Reiche) Ulibarri (serie *Glutinosae* Burkart), se separa por poseer folíolos pequeños y largos pedicelos glandulosos (Ulibarri, 1986).

Paratipo. CHILE. **IV Región** (Coquimbo). Dpto. Ovalle: Quebrada La Placa, en ripio de quebrada seca, Sep. 1954, *C. Jiles 2784* (CONC, SI).

2. Adesmia argyrophylla Philippi, Linnaea 28: 631. 1857. TIPO: Chile. "In andibus provinciae Coquimbo ad Huanta", *C. Gay 570* (holotipo, SGO 50206; isotipo y foto, SI).

Adesmia sessiliflora Philippi, Viage al desierto de Atacama (Fl. atacam.: 16). 1860. Syn. nov. TIPO: Chile. "Chañaral bajo, desert. Atacama, jan. 1854" (lectotipo, aquí designado, SGO 40244; isotipo y foto, SI).

Adesmia kingi Philippi, Anales Univ. Chile 41: 706. 1872. Syn. nov. TIPO: Chile."Yerbas Buenas, al oriente de Carrizal" *T. King 1871/72* (holotipo, SGO 50192; isotipo y foto, SI).

Adesmia furcata Philippi, Anales Univ. Chile 84: 434. 1893. TIPO: Chile. "Quebrada del Molle", *G. Giesse s.n.* (holotipo, SGO no visto).

Arbusto de 0.50–1 m alt., espinoso, con pubescencia aplicada y corta a subpatente, grisáceo-plateado a glabrescente con la edad. Hojas de 1–3 cm, estípulas pequeñas, deltoides; con (2–)3–4(–5) pares de folíolos, obovados, conduplicados, de 1.5–5 × 0.5–1.5 mm, pubescentes a glabrescentes, raro con algunos pelos glandulosos. Flores de 5–7 mm, sobre pedicelos de 1–3(–4.5) mm, en todas las espinas del ramillete; cáliz pubescente a subglabro, con tubo de 2.5 mm long., dientes muy angostos y agudos, 1.5–2 mm; estandarte generalmente piloso en el dorso. Lomento 2–6 articulado, artejos de 3.5–4 × 3.5–4 mm.

Distribución, ecología y fenología. Habita en el norte de Chile, III y IV Región, en zonas áridas, entre los 200–2200 m.s.m. En flor y fruto desde septiembre a noviembre.

Observaciones. El estudio de los tipos nomenclaturales de *Adesmia argyrophylla*, *A. kingi* y de *A. sessiliflora*, y del material adicional, permitió confirmar que se trata de un sólo taxón por compartir idénticos caracteres, motivo por el cual se establece la sinonimia arriba expuesta.

Con respecto al tipo nomenclatural de *Adesmia sessiliflora* se ha elegido el material SGO 40244 y no SGO 50160, por poseer el primero mejor material foliar, flores y frutos en SGO con su correspondiente fotografía y mejor isotipo conservado en SI; quedando el segundo como un paralectotipo.

Se confirma también la sinonimia realizada por Burkart (1967) de *Adesmia furcata* con *A. argyrophylla*. De *A. furcata* se ha analizado un probable paratipo: Chile [Antofagasta] "Bandurrias, *G. Giesse s.n.*, año 1888" (SI 7118). Faltaría en cambio un estudio de los sintipos, SGO 50194 y 50389 de *Patagonium divaricatum* Phillipi ex Reiche, según Muñoz Schick (1971) para lectotipificar este nombre, que seguramente se trata de otro sinónimo de *A. argyrophylla*.

Material selecto examinado. CHILE. **III Región** (Atacama). Huasco: Cachiyuyo, 19 Sep. 1957, *A. L. Cabrera 12690* (SI); Agua Amarga, 20 Sep. 1952, *C. Jiles 2219* (SI); Qda. de Pasto Cerrado, 23 Oct. 1925, *I. Johnston 4715* (BA, SI); "In rupium fissuris ad rivulum horto loci Finca de Chañaral", Ene. 1854, *Philippi s.n.* (SGO 50160, SI); Cachiyuyo, 19 Sep. 1957, *M. Ricardi & C. Marticorena 4473* [CONC 25021] (SI). **IV Región** (Coquimbo). Choros Bajos, 12 Oct. 1965, *O. Zöllner 718* (SI).

3. Adesmia littoralis Burkart, Darwiniana 14(2–3): 548. 1967. TIPO. Chile. (IV Región). Coquimbo: Morillo, "ad littore oceanis pacifici", Oct. 1966, *A. Kohler 581* (holotipo, SI).

Subarbusto, ca. 40 cm alt., incano, blanquecino. Hojas de 2–3.2 cm; folíolos 3–6 pares, obovados, de 3.5–8 × 2.5–4 mm, incanos. Flores de (7–)10–11 mm; pedicelos de 2–5 mm; cáliz pubescente, tubo 2.5–4 mm, dientes agudos aleznados de 1.5–2.5 mm; estandarte pubescente en el dorso. Lomento 2–4 articulado, artejos de 5–6 × 4–5.5 mm, de margen prominente, cerdas pilosas de 1–3 mm.

Distribución, ecologia y fenología. Fanerófito que habita en el litoral árido y arenoso del Pacífico de Chile septentrional (30° lat. S); integrando la flora de las dunas chilenas con carácter psamófilo, halófito y xerófito como respuesta a las condiciones extremas del hábitat (San Martín et al., 1992). En flor y fruto en septiembre y diciembre.

Nombre vernáculo. "Paramela" (San Martín et al., 1992).

Material selecto examinado. CHILE. **III Región** (Atacama). Pto. Viejo, near Copiapó, 6 Oct. 1994, *D. Benyamini 101* (SI); N de Huasco, "sea level, a very large bush in the coastal sand dunes", 31 Dec. 1998, *D. Benyamini 583* (SI); Huasco, en la playa, 29 Sep. 1952, *M. Ricardi 2269* [CONC 12924] (SI). **IV Región** (Coquimbo). Cuesta de la Viñita, 21 Sep. 1957, *M. Ricardi & C. Marticorena 4535* [CONC 25083] (SI).

Se brinda la siguiente clave que permite identificar las especies de la serie *Argyrophyllae*:

1. Arbustos incanos, blanquecinos, de pocas espinas, flores de (7–)10–11 mm, artejos de 5–6 × 4–5.5 mm, con cerdas pilosas breves que no sobrepasan el margen . . . . . *A. littoralis* Burkart

1′. Arbustos glabrescentes a seríceo-pubescentes pero no incanos, con abundante sistema espinoso, flores de (5–)6–7 mm, artejos de 3.5–4 × 3.5–4 mm, con cerdas plumosas largas que sobrepasan el margen.

2. Flores con pedicelos de 5–8(–11) mm, dientes del cáliz deltoides, menores que el tubo a veces inconspicuos, arbustos glabrescentes, eglandulosos; folíolos generalmente extendidos, distanciados entre sí, emarginados. . . . . *A. ovallensis* Ulibarri

2′. Flores subsésiles o con pedicelos de 1–4.5 mm, dientes del cáliz agudos a menudo igualando al tubo en long., arbustos con ramas pubescentes, indumento adpreso a patente y muy corto, grisáceo-plateados, raro con algunos pelos glandulosos a glabrescentes con la edad; folíolos conduplicados, más bien próximos entre sí, obtusos . . . . . *A. argyrophylla* Philippi

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Lectotypification for *Wisteria fallax* (Fossil Leguminosae) from the Neogene of Japan

Wang Qi

State Key Laboratory of Systematic and Evolutionary Botany, Institute of Botany, Chinese Academy of Sciences, Beijing 100093, People's Republic of China. happyking@ibcas.ac.cn

ABSTRACT. Lectotypification for a legume fossil species, *Wisteria fallax* (Nathorst) Tanai & Onoe from the Neogene of Japan, is presented here. A figure previously designated as the lectotype for *W. fallax* by Tanai is not tenable because the ICBN (St. Louis Code, Art. 8.5 and 9.13) does not allow a figure to serve as the type for the name of a fossil taxon.

Key words: Legume fossil, Leguminosae, Neogene, *Wisteria*.

Nathorst (1883) described four specimens of problematic legume fossil leaflets as *Sophora* (?) *fallax* from the Late Pliocene Mogi flora of Japan, but he did not cite specimens in the protologue. Tanai and Onoe (1961) transferred Nathorst's species to another legume genus, i.e., *Wistaria fallax* (Nathorst) Tanai & Onoe, based upon additional leaflet specimens from the Mio-Pliocene "Hoki flora" of Japan and designated one holotype (GSJ 4165, Geological Survey of Japan) and four paratypes (GSJ 4166, GSJ 4167, GSJ 4168, and GSJ 4169) for this new combination. However, the type designation was incorrect because it was not done on the basis of Nathorst's (1883) original specimens. Tanai (1976) re-investigated Nathorst's specimens deposited at the Swedish Museum of Natural History (S) and designated a figure (Nathorst, 1883: plate 10, fig. 12) as a lectotype for *W. fallax*, because there were no specimen numbers attached at that time. Meanwhile, Tanai drew an illustration (Tanai, 1976: 327, text-fig. 5f; in this paper: Fig. 1C) to show the partial leaflet architectural detail of the specimen in the figure designated as the lectotype. However, the illustration actually corresponded to another figure (Nathorst, 1883: plate 10, fig. 11). Nathorst's (1883) figures 11 and 12 respectively represent part and counterpart of the same specimen (Fig. 1A, D). Under such circumstances, the figure designated by Tanai (1976) may not be selected as the type because the *International Code of Botanical Nomenclature* (St. Louis Code, Art. 8.5 and 9.13, Greuter et al., 2000) does not allow a figure to serve as the type for the name of a fossil taxon. Thus, the figure designated as the lectotype and the illustration drawn by Tanai (1976) should correctly correspond to a specimen. In recent years, the electronic registration of the fossil plant collections, especially from the Cenozoic, at the Swedish Museum of Natural History is being completed gradually, and Nathorst's (1883) original specimens described as *Sophora* (?) *fallax*, including the lectotype selected here, have been given registered numbers (Fig. 1A, D). Therefore, it is high time to make a lectotypification for *Wisteria fallax*.

Wisteria fallax (Nathorst) Tanai & Onoe, Geol. Surv. Jap. Rep. 187: 45, 1961, as "*Wistaria fallax*." Basionym: *Sophora* (?) *fallax* Nathorst, Kongl. Svensk. Vet.-Akad. Handl. 20(2): 58, pl. 10, fig. 11. 1883. TYPE: Japan. Kyushu: Nagasaki City, Mogi, Late Pliocene, Mogi Formation in the northern coastal area of Mogi-machi E of Nagasaki City, 1879, *A. E. Nordenskiöld*, *S113034a* (lectotype, designated here, S; duplicate, *S113034b*, S (fossil part and counterpart)). Figure 1.

Leaflets narrow-ovate in shape, 4.3–6 × 1.8–2.6 cm; petiolule ca. 2–3 mm; apex acuminate or acute; base symmetrical or slightly asymmetrical, obtuse or rounded; midvein stout, straight; secondary veins slender, rarely branched, 7 to 10 pairs, brachidodromous, spacing and angle of divergence variable, 45°–70° at base, 50°–80° in middle, and 60°–80° at apex; vein course sinuous, slightly zigzag or curved; intersecondary veins 4 to 6, often including 1 basal pair, 1/3–1/2 (or more) distance from midvein to margin; tertiary veins random reticulate with some alternate percurrent, sinuous, simple or forked; quarternary veins polygonal; fifth and higher order venations indistinct; marginal ultimate veins forming 1 or 2 series of loops, the outer one very close to margin; margin entire; texture seemingly membranaceous; cuticle unavailable.

Wisteria fallax is a common leaflet fossil from the Neogene (specifically, middle Miocene to late Pliocene) of Japan (Tanai, 1961, 1976; Uemura,

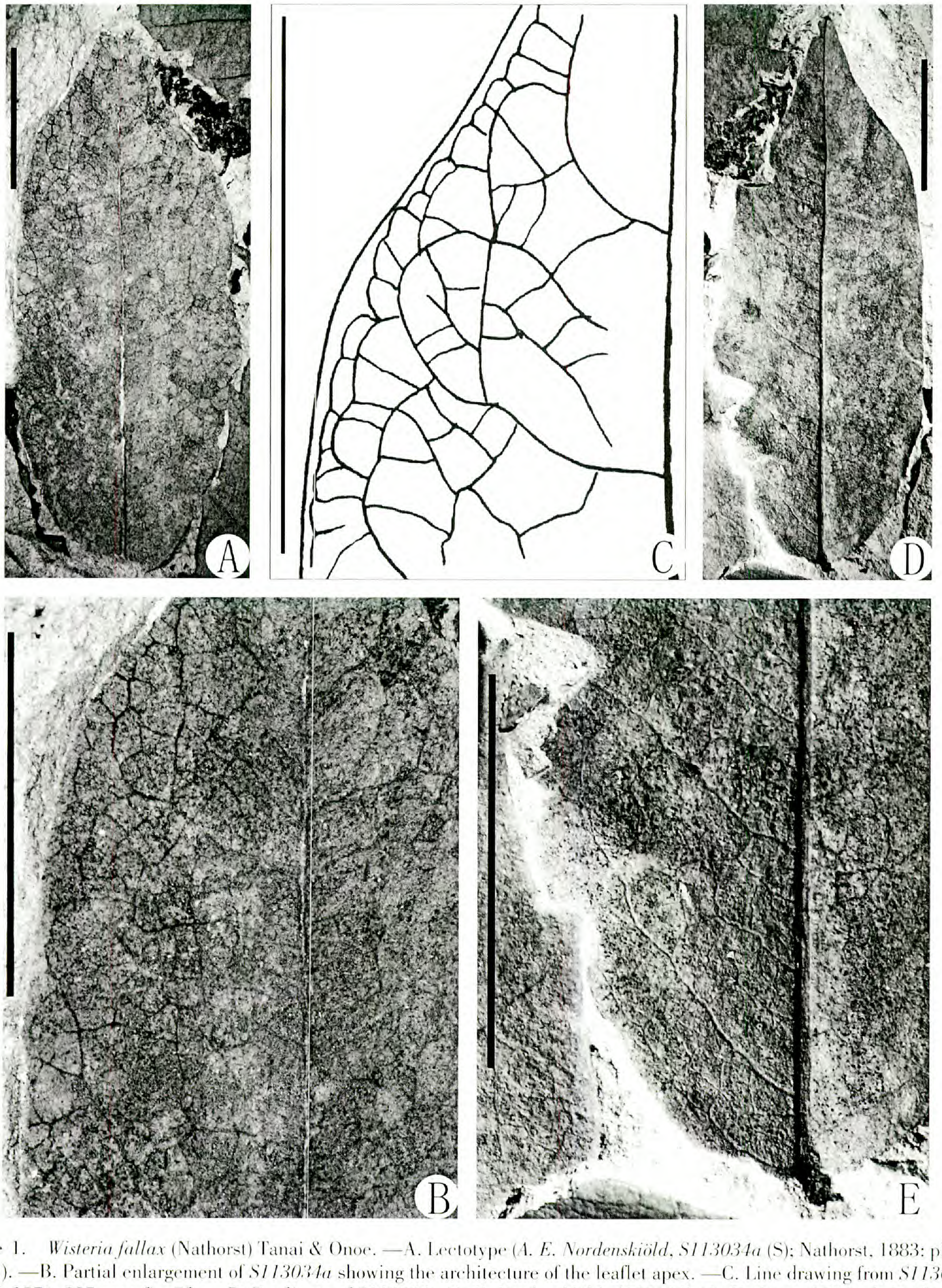

Figure 1. *Wisteria fallax* (Nathorst) Tanai & Onoe. —A. Lectotype (*A. E. Nordenskiöld, S113034a* (S); Nathorst, 1883: pl. 10, fig. 11). —B. Partial enlargement of *S113034a* showing the architecture of the leaflet apex. —C. Line drawing from *S113034a* (Tanai, 1976: 327, text-fig. 5f). —D. Duplicate of *S113034a* (*A. E. Nordenskiöld, S113034b* (S); Nathorst, 1883: pl. 10, fig. 12). —E. Partial enlargement of *S113034b* showing the architecture of the leaflet base. Scale bars = 1 cm. Note that A and D represent part and counterpart of the same specimen.

1988), and some coeval fruit fossils were also included in this taxon (Tanai & Onoe, 1961; Tanai, 1961). These fruit fossils were reported from the Miocene Jōban coal field (Tanai & Onoe, 1959) and the Pliocene Stegodon beds (Miki, 1937) in Japan. Recently, nomenclatural notes on *W. fallax* and related taxa have been given by Wang et al. (2006), who suggested that the taxonomy of the fruit fossils previously included in *W. fallax* should be reconsidered. Because there is not sufficient evidence to warrant these detached leaflets and fruits from various localities to be placed in the same taxon, the present

author suggests that *W. fallax* should be used only for leaflet fossils.

Additional specimens examined. JAPAN. **Kyushu:** Nagasaki City, Mogi, Late Pliocene, Mogi Formation in the northern coastal area of Mogi-machi E of Nagasaki City, 1879, *A. E. Nordenskiöld*, *S113036*, *S113037* (S).

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Publication History and Lectotypification of *Mentzelia arborescens* (Loasaceae)

Maximilian Weigend

Institut für Biologie, Systematische Botanik und Pflanzengeographie, Freie Universität Berlin, Altensteinstr. 6, D-14195 Berlin, Germany. weigend@zedat.fu-berlin.de

Abstract. The confusing publication history of the name *Mentzelia arborescens* Urban & Gilg is clarified. The first publication of the name by I. Urban in 1892 referred only to a floral diagram and should not be considered as valid publication. Subsequently, the name was taken up by E. Gilg in 1893 in *Die natürlichen Pflanzenfamilien* and described in detail as the only representative of the newly described *Mentzelia* L. sect. *Dendromentzelia* Urban & Gilg. This should be considered as the valid publication of the name. The material seen by the authors, however, was not cited in publication until 1900. A search for the original material led to the discovery of two Karwinski specimens in the Munich herbarium (M), which bear handwritten labels by Urban and Gilg dated 1892, and are therefore suitable as lectotypes of the name. One of them is here formally designated as the lectotype.

Key words: Loasaceae, *Mentzelia*, typification.

Mentzelia arborescens Urban & Gilg is the only species of *Mentzelia* L. sect. *Dendromentzelia* Urban & Gilg and appears to be a rare and narrowly endemic species restricted to southern Mexico (Oaxaca; Darlington, 1934). In preparation of the *Flora Mesoamericana* treatment of Loasaceae, a formal typification of the name and a clarification of the valid publication date are required.

The name *Mentzelia arborescens* was used in three publications of I. Urban and E. Gilg (Gilg, 1893; Urban, 1892; Urban & Gilg, 1900). Usually, *M. arborescens* is cited as published in Urban and Gilg (1892: 265, t. 14, fig. 8; cf. Darlington, 1934), but a study of the original publication reveals that the name is there only used in the legend of a table with floral diagrams, without any further description, nor citation of a specimen.

This designation may therefore be considered as a nomen nudum. A validating description of the taxon was provided in Gilg (1893) in his treatment of Loasaceae in *Die natürlichen Pflanzenfamilien*, where he described unispecific *Mentzelia* sect. *Dendromentzelia* in detail, with *M. arborescens*. Gilg explicitly gave Urban & Gilg as the authors of this species, despite the fact that he figured as sole author for this article. This publication should be considered as validating the species name. *Mentzelia arborescens* retains priority, because the only synonym of *M. arborescens*, *M. conzattii* Greenman, was published in 1897. Not until Urban and Gilg's *Monographia Loasacearum* (1900) is there finally a published reference to those specimens the authors had seen of *M. arborescens*.

Mentzelia arborescens is based on six collections, all from from Oaxaca, Mexico (*C. Conzatti 62*, *H. Cuming s.n.*, *C. A. Ehrenberg 1297*, *H. Galeotti 3682*, *A. Ghiesbrecht s.n.* [these not located], and *W. Karwinski s.n.*). In the author's search for the original material, two specimens by Karwinski were located in the Munich herbarium (M). These specimens were cited by Urban and Gilg (1900) and bear hand-written labels by those authors dated to 1892. They may therefore be regarded as relevant choices for the original material for *M. arborescens*, and one of these two specimens, the more complete and better-preserved specimen (several flowers open and well preserved vs. in bud or moth-eaten in the other specimen), is here selected as the lectotype of that name. It is very likely that both specimens correspond to a single gathering, but they lack collection numbers and the labels are marginally different.

Mentzelia arborescens Urban & Gilg, in Engler & Prantl, Nat. Pflanzenfam. III(6a): 110. 1894. TYPE: Mexico. [Oaxaca:] s.d., *W. Karwinski s.n.* (lectotype, designated here, M). Figure 1.

Mentzelia conzattii Greenman, Proc. Amer. Acad. Arts 32: 298. 1897. TYPE: Mexico. Oaxaca: Oaxaca, 1500 m, 19 Dec. 1906, *C. Conzatti 62* (GH).

Additional specimen examined. Mexico. [**Oaxaca**:] Teoxomulco, *W. Karwinski s.n.* (M).

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Figure 1. Lectotype specimen of *Mentzelia arborescens* Urban & Gilg: *Karwinski s.n.* (M).

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Parrya nauruaq (Brassicaceae), a New Species from Alaska

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
ihsan.al-shehbaz@mobot.org

Jason R. Grant
Laboratoire de Botanique Évolutive, Institut de Botanique, Faculté des Sciences, Université de Neuchâtel, rue Émile-Argand 11, Case Postale 158, 2009 Neuchâtel, Switzerland.
jason.grant@unine.ch

Robert Lipkin
Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501, U.S.A. anrl@uaa.alaska.edu

David F. Murray and Carolyn L. Parker
University of Alaska Museum of the North, 907 Yukon Drive, Fairbanks, Alaska 99775-6960, U.S.A. ffdfm@uaf.edu; fnclp1@uaf.edu

Abstract. *Parrya nauruaq* Al-Shehbaz, J. R. Grant, R. Lipkin, D. F. Murray & C. L. Parker (Brassicaceae) is described from the Seward Peninsula of Alaska. It differs from the other North American species in *Parrya* R. Brown by its smaller flowers and fruits, and by its fewer seeds per fruit. A key to the four North American species of *Parrya* is provided.

Key words: Alaska, Brassicaceae, North America, *Parrya*.

Parrya R. Brown is a genus of 25 to 36 species, the majority of which are distributed in Central Asia and the Himalayas, with a minor representation in North America (Appel & Al-Shehbaz, 2003). It is a distinctive genus easily distinguished by its scapose habit, frequent presence of multicellular glands with multiseriate stalks, accumbent cotyledons, winged seeds, ebracteate racemes, flattened replum, and latiseptate fruits (flattened parallel to the septum) not readily detached from the fruiting pedicel. *Parrya* was reduced to a monotypic genus, with *P. arctica* R. Brown as the type, by Botschantzev (1972), who transferred almost all of the species to *Neuroloma* Andrzejowski ex DC. However, such delimitation is unwarranted based on molecular studies in progress by one of us (Grant).

There are four species of *Parrya* in North America, including the novelty described below. Of these, *P. arctica* is distributed in the Canadian Arctic islands of the Northwest Territories and Nunavut. Its major center of distribution falls between 93°–125°W and 67°–76°N (authors' compilation).

Parrya nudicaulis (L.) Regel was divided by Hultén (1971) into six subspecies, and its range was said to extend from the Canadian Arctic and Alaska into the Russian Far East, Siberia, Central Asia, China, and the Himalayas. However, molecular studies and a critical evaluation of morphology (Grant, unpublished data) indicate that the species appears to be restricted to Alaska, Canada (Yukon and Northwest

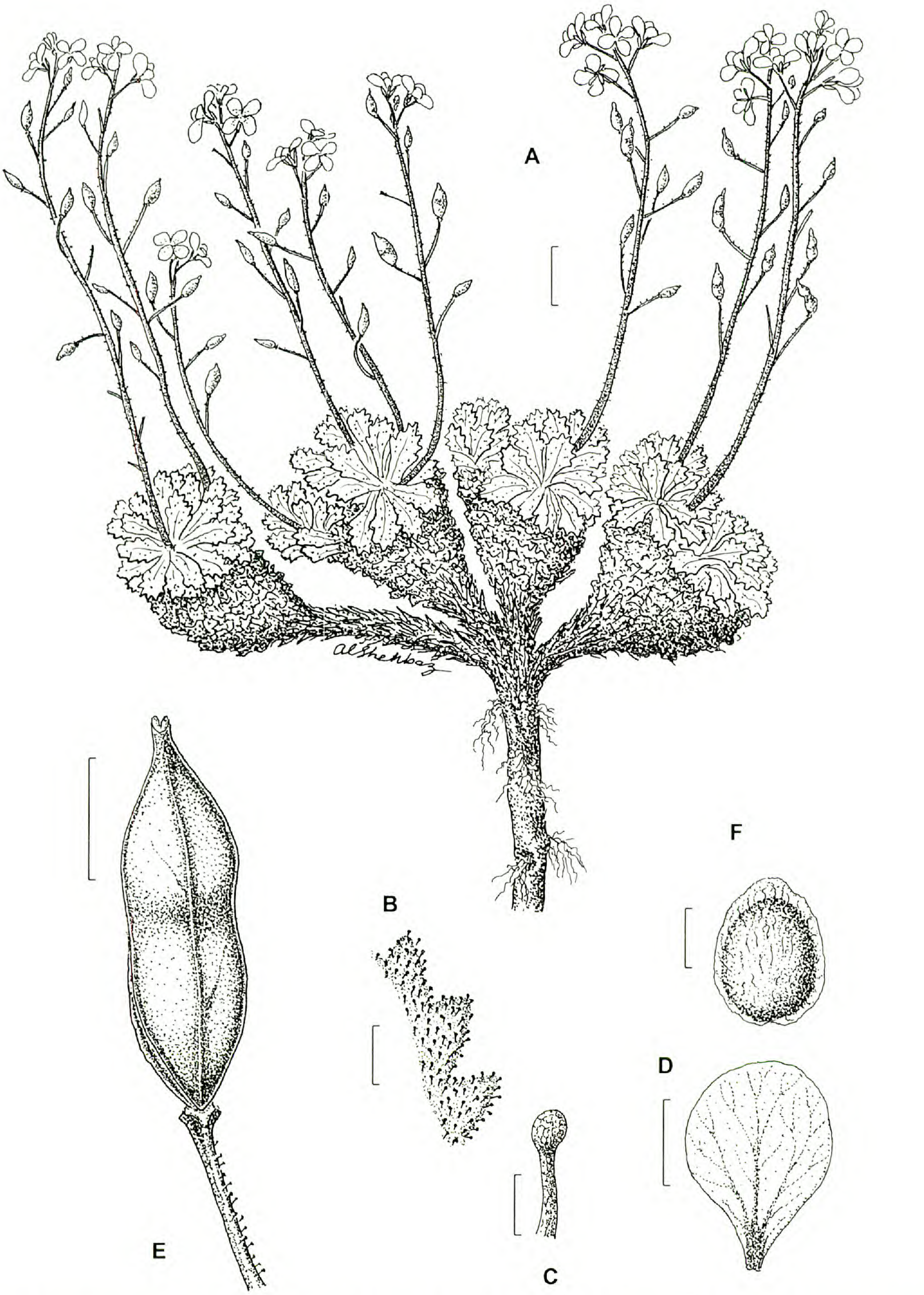

Figure 1. *Parrya nauruaq* Al-Shehbaz, J. R. Grant, R. Lipkin, D. F. Murray & C. L. Parker. —A. Plant. —B. Portion of leaf showing glands. —C. Gland. —D. Petal. —E. Fruit. —F. Seed. Scale bars: A = 1 cm; B = 1 mm; C = 0.1 mm; D = 2 mm; E, F = 5 mm. Drawn by Ihsan A. Al-Shehbaz: A–D from the isotype, *Parker, Lipkin & Meyers 15987* (MO); E, F from the paratype, *Parker & Beattie 15451* (MO).

Territories), and the Russian Far East. Specimens previously attributed to *P. nudicaulis* from the Himalayas (e.g., Tibet and India) and Central Asia represent at least three other species, necessitating a reconsideration of the species limits of *P. nudicaulis* s.l. in Asia.

The third species, *Parrya rydbergii* Botschantzev, is a narrow endemic restricted to the Uinta Mountains and Mount Emmons in Utah (Daggett, Duchesne, Summit, and Uintah Counties) and the Big Sheep and Beartooth Mountains in Wyoming (Park and Sublette Counties), U.S.A. It was reduced by Rollins (1993) to synonymy of *P. nudicaulis* and was treated by Hultén (1971) as a subspecies and by Holmgren (2005) as a variety of that species. However, the two species are geographically disjunct and can easily be distinguished morphologically (see key).

The fourth species, *Parrya nauruaq* Al-Shehbaz, J. R. Grant, R. Lipkin, D. F. Murray & C. L. Parker, which was first collected by Parker in July 1982 and subsequently by others (see below), is described herein as a new species.

Genus-wide molecular systematic studies on *Parrya* are in progress (Grant, in prep.). Preliminary results based on nuclear ribosomal internal transcribed spacer (ITS) and 5S non-transcribed spacer (5S-NTS) sequences of 14 species represented by some 90 samples (including nearly 40 of *P. nudicaulis* s. str.) indicate that the four North American species (*P. arctica*, *P. nauruaq*, *P. nudicaulis*, and *P. rydbergii*) are closely related and form a monophyletic group. Both *P. arctica* and *P. rydbergii* are phylogenetically distinct from *P. nudicaulis*, whereas *P. nauruaq* shows a closer relationship to *P. nudicaulis* (and secondarily to *P. arctica*, supporting the floral and leaf morphological differences between the species as indicated below.

Parrya nauruaq Al-Shehbaz, J. R. Grant, R. Lipkin, D. F. Murray & C. L. Parker, sp. nov. TYPE: U.S.A. Alaska: Nome Quadrangle, Seward Peninsula, 12 km NNE of Cape Rodney, Moon Mtns., 64°44′06″N, 166°20′05″W, 15–100 m, 8 June 2005, *C. L. Parker, R. Lipkin & C. R. Meyers 15987* (holotype, ALA; isotype, MO).

Herba perennis caespitosa, scaposa, glandulosa. Folia basalia obovata vel late spathulata, 0.6–1.5(–2) × 0.4–0.8(–1) cm, dentata vel subintegra. Racemi 6- ad 16-flori; pedicelli fructiferi divaricati-adscendentes, 0.5–0.9(–1.2) cm longi. Sepala ovata, 2.5–3.5(–4.1) × 1.2–1.7 mm; petala pallide violacea, atrovenosa, obovata, 6–8(–9.1) × 3–5 mm, apice rotunda; ovula 6 ad 8. Fructus obovati vel oblongi, 0.8–1.4(–1.7) cm × 5–7 mm. Semina suborbicularia vel late ovata, 4–6 × 3.5–5 mm; ala 0.8–1.5 mm lata.

Plants densely caespitose, scapose perennial, moderately to densely glandular on leaves and scapes, trichomes absent; caudex branched, densely covered with petiolar remains or leaves of previous years; stems 4–8 cm. Basal leaves rosulate; petiole 0.2–1 cm, 2–4 mm wide at base; leaf blade obovate to broadly spatulate, 0.6–1.5(–2) × 0.4–0.8(–1) cm, base cuneate, coarsely dentate to subentire, apex acute; cauline leaves absent. Racemes 6- to 16-flowered; fruiting pedicels divaricate-ascending, lowermost 0.5–0.9(–1.2) cm. Sepals ovate, 2.5–3.5(–4.1) × 1.2–1.7 mm, eglandular; petals pale violet with distinctly darker veins, broadly obovate, 6–8(–9.1) × 3–5 mm, apex rounded; claw 2–3.5 mm; median filaments 2.5–3 mm; anthers oblong, 0.9–1 mm. Fruits obovate to oblong, 0.8–1.4(–1.7) cm × 5–7 mm; valves with a prominent midvein, eglandular or sparsely glandular; style 0.2–1 mm; ovules and seeds 6 to 8 per fruit (rarely up to 4 seeds produced). Seeds suborbicular to broadly ovate, flattened, 4–6 × 3.5–5 mm, with a broad wing 0.8–1.5 mm wide.

Etymology. The specific epithet "*nauruaq*" means "flower," "plant," or literally, "something that grows" in Inupiaq, the language of the Inuit. It is a noun used in apposition and, therefore, is to be maintained according to Article 23.1 of the *International Code of Botanical Nomenclature* (McNeill et al., 2006).

Parrya nauruaq grows on floodplains and slopes with fine to gravel-sized, weathered carbonate rocks on nearly unvegetated landscape. By contrast, *P. nudicaulis*, which also occupies these general habitats, grows on slightly moister sites often with greater vegetation cover, though very rarely both species grow together in sites with extremely low plant cover. In addition, *P. nauruaq* has pale violet, distinctly smaller flowers (petals 6–8(–9.1) mm long with darker veins) and a musky fragrance, whereas *P. nudicaulis* has purplish, considerably larger flowers (petals 14–22 mm long with fainter veins) and a sweet fragrance. In the very few cases where the two species grew side by side, they were distinct and with no sign of intergrading. The two species can easily be distinguished from a distance by their habit. *Parrya nauruaq* is caespitose and with a thick woody caudex densely clothed in leaves of previous seasons, whereas *P. nudicaulis* is not caespitose and with a slender caudex often not clothed with leaf remains. The new species is readily separated from the other three North American *Parrya* species by the following key.

Key to the North American Species of *Parrya*

1a. Sepals 2.5–3.5(–4.1) mm long; petals 6–8(–9.1) mm long, apex often rounded; ovules and seeds 6 to 8 per fruit; fruit obovate to oblong-obovate, 0.8–1.4(–1.7) cm long . . . . . *P. nauruaq*

1b. Sepals (3–)4–8 mm long; petals (8–)10–22 mm long, apex emarginate; ovules and seeds 10 to 20 per fruit; fruit narrowly oblong to linear-lanceolate, (1–)1.5–5 cm long.
2a. Leaves linear to linear-oblanceolate, 2–5 (–7) mm wide; sepals (3–)4–5 mm long; petals (8–)10–13 × 3–5 mm, claws 3.5–4.5 mm long; plants eglandular; ovules and seeds 14 to 20 per fruit . . . . . *P. arctica*
2b. Leaves obovate, spatulate, broadly oblanceolate, lanceolate, or oblong, (6–)10–28 mm wide; sepals 5–9 mm long; petals (14–)16–23 × 7–12 mm, claws 6–12 mm long; plants glandular or eglandular; ovules and seeds 10 to 16 per fruit.
3a. Leaves incised to coarsely dentate; lower fruiting pedicels 0.4–1.5(–2) cm long; plants densely glandular, very rarely eglandular, densely caespitose; filaments 4–6 mm long; Utah and Wyoming . . . . . *P. rydbergii*
3b. Leaves entire, minutely to coarsely dentate, rarely incised; lower fruiting pedicels (1–)1.5–4(–6) cm long; plants eglandular or glandular, not caespitose; filaments 6–10 mm long; Alaska, Northwest Territories, and Yukon . . *P. nudicaulis*

Chromosome numbers were determined by Grant in Neuchâtel from floral buds fixed in the field in Carnoy's solution. Haploid counts ($n = 7$) were obtained from pollen mother cells, and diploid counts ($2n = 14$) were made from ovary tissues for both *Parrya nudicaulis* (voucher: *Parker 16029* at ALA) and *P. nauruaq* (voucher: *Parker 16001* at ALA). These chromosome counts are in agreement with previously published counts of *Parrya* (see Warwick & Al-Shehbaz, 2006).

Paratypes. U.S.A. **Alaska:** Nome Quadrangle (all from the Seward Peninsula): Moon Mtns., badlands habitat, 170 m, 30 June 1997, *D. F. Murray & R. Lipkin 12220* (ALA); 10 km NNE of Cape Rodney, low uplands N of Sinuk, 30 m, 19 Aug. 2003, *C. L. Parker & K. Beattie 15451* (ALA, MO); 12 km NNE of Cape Rodney, 30 m, 18 Aug. 2003, *Parker & Beattie 15404* (ALA, MO); 12 km NNE of Cape Rodney, Moon Mtns., 15–100 m, 7 June 2005, *Parker, Lipkin & C. R. Meyers 15969* (ALA, MO); 9 km NE of Cape Rodney, Moon Mtns., 15–80 m, 9 June 2005, *Parker, Lipkin & Meyers 16001* (ALA, MO); 9 km NE of Cape Rodney, Moon Mtns., 15–80 m, 9 June 2005, *Parker, Lipkin & Meyers 16014* (ALA, MO); 12 km NNE of Cape Rodney, Moon Mtns., NW corner, 30–100 m, 10 June 2005, *Parker, Lipkin & Meyers 16030* (ALA, MO). Solomon Quadrangle: Council Rd., calcareous scree, 2 July 1982, *Parker 230* (ALA); Council Rd., bluffs above Salmon River, 22 June 1983, *S. Kelso 83-25* (ALA).

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Onosma bisotunensis (Boraginaceae), a New Species from Western Iran

Farideh I. Attar
Central Herbarium, Department of Botany, Faculty of Science, Tehran University, Tehran, Iran.
fattar@khayam.ut.ac.ir

Behnam Hamzeh'ee
Department of Botany, Research Institute of Forest and Rangeland, Tehran, Iran.
hamzehee@rifr-ac.ir

Abstract. *Onosma bisotunensis* Attar & Hamzeh'ee (Boraginaceae), a new species from western Iran, is described and illustrated. It is distinguished from its nearest relative, *O. hebebulbum* DC., by having a pilose (vs. glabrous) nectariferous ring, a bilabiate (vs. regular) calyx with two or three basally connate (vs. free) lobes and larger corolla ca. 19 mm (vs. 15 mm) long and pubescent (vs. densely villous) outside, and anthers 8–8.5 mm (vs. 6–7 mm) long.

Key words: Boraginaceae, Iran, *Onosma*.

During recent floristic and phytosociologic studies in western Iran by the second author, many new or rare species were collected. Among these is a new species of *Onosma* L. (Boraginaceae) described below as *O. bisotunensis* Attar & Hamzeh'ee. *Onosma* includes about 55 species, of which 17 are endemic to Iran, where they are distributed primarily in the central, western, and southwestern portions of the country (Riedl, 1968). The new species has stellate hairs and belongs to a group of 11 Iranian species distributed in Kurdistan, Kermanshah, and Boyer-Ahmad provinces of the Zagros Mountains (Riedl, 1968; Ghahreman & Attar, 1996).

Onosma bisotunensis Attar & Hamzeh'ee, sp. nov. TYPE: Iran. Kermanshah: Kermanshah–Kamyaran rd., Vermanjeh, 1500–1700 m, 15 Apr. 2001, *Behnam Hamzeh'ee & Unes Asri 80844* (holotype, TARI). Figure 1.

Perennis, basi lignosa, usque 25 cm alta. Folia basalia ovata vel spathulata 1.5–2 × ca. 1 cm, petiolo breviusculo 0.5–2 cm, indumento e setis appressis basaliter tuberculis pilosis praeditis et inter setas e pilis brevibus numerosissimis obsita; folia caulina acuta vel apiculata. Inflorescentiae subcapitatae, terminales; bracteae ovatae, ca. 18 × 6 mm, superiores anguste lineares, usque 10 × 1.5 mm; pedicelli usque 3 mm longi, setosi. Calyces ca. 13 mm longi, bilabiati albido-setosi, lobis ca. 2 mm latis; corolla ca. 19 mm longa, flava, in sicco cyanea, campanulato-cylindrica, extra pubescens, intus glabra, lobis 5, triangularibus, 2–2.5 × ca. 2 mm, revolutis; annulus nectarifer villosus; filamenta compressa basin versus angustata, ca. 7 mm longa, fere ca. 7 mm supra basin corollae inserta; antherae 8–8.5 mm longae, sagittatae, lineares, per totam longitudinem liberae, basibus raro cohaerentibus, subexsertae; stylus filiformis, corollam superans; stigma minutissimum. Nuculae ignotae.

Perennial, woody at base, up to 25 cm tall; flowering stems ascending, simple or branched above; setae patent or adpressed, with indistinct glabrous or pilose tubercle at base, densely shortly pubescent between setae. Basal leaves ovate or spatulate, 1.5–2 × ca. 1 cm, petiole 0.5–2 cm, with long-adpressed setae on stellate-pilose tubercles, sparsely pubescent between setae; stem leaves 20–30 × 8–13 mm, remote, ovate, sessile, acute or apiculate. Inflorescences densely congested, subcapitate, 1 or 2; lower bracts leaf-like, ca. 18 × 6 mm; upper bracts narrowly linear, up to 10 × 1.5 mm; pedicel up to 3 mm, setose. Calyx ca. 13 mm, lobes ca. 2 mm wide, bilabiate, 2 or 3 connate, densely covered by appressed setae and pubescence, white at base with sericeous setae; corolla ca. 19 mm, yellow, sometimes dark blue with age, cylindric-campanulate, pubescent outside; lobes 5, triangular, 2–2.5 × ca. 2 mm, revolute; nectariferous annulus villous; filaments ca. 7 mm, compressed, attenuate toward base, inserted ca. 7 mm above the base; anthers 8–8.5 mm, sagittate at base, with sterile tips, slightly exserted, free or rarely connate at base; style filiform, long-exserted; stigma small. Mature achenes unknown.

Habitat. *Onosma bisotunensis* grows in *Quercus brantii* Lindley and *Acer monspessulanum* L. communities on limestone substrates. This species was found only in a limited area, and we could not find any specimens in other herbaria such as TARI, TUH, and IRAN.

Relationships. *Onosma bisotunensis* is distributed in a small area of Kermanshah Province in western Iran. It is distinguished from its nearest relative, *O. hebebulbum* DC., which is distributed between Mehran

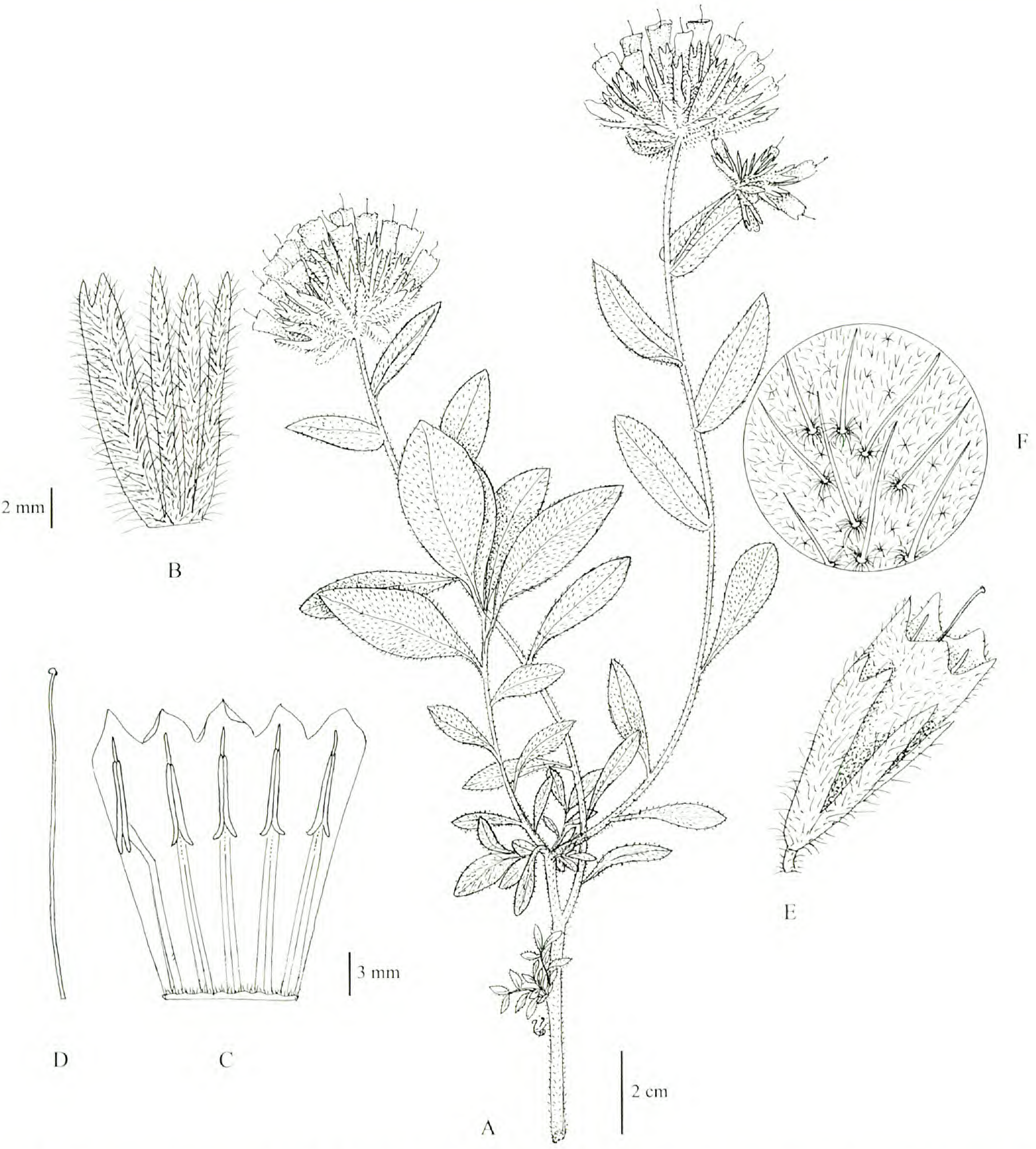

Figure 1. *Onosma bisotunensis* Attar & Hamzeh'ee. —A. Habit. —B. Calyx. —C. Corolla. —D. Style. —E. Corolla and calyx. —F. Tubercled setae. Scale bar for C applies to E. Drawn from the holotype, *Hamzeh'ee & Asri 80844* (TARI).

and Ilam in Ilam Province, by its villous nectariferous ring, bilabiate calyx ca. 13 mm long with two or three basally connate lobes, larger corolla (ca. 19 mm) that is pubescent outside and initially yellow sometimes becoming dark blue, and anthers 8–8.5 mm long. In contrast, *O. hebebulbum* has a glabrous nectariferous ring, a regular calyx 12–17 mm long with free lobes, smaller (ca. 15 mm) corollas that are densely villous outside and initially creamy white becoming blue, and anthers 6–7 mm long.

Discussion. The genus *Onosma* consisted of 59 species in *Flora Iranica* in three sections: *Protonosma* M. Popova, *Podonosma* (Boissier) Gurcke, and *Onosma* L. The section *Onosma* includes one subsection, *Onosma*, with 22 series. The series *Alborosei* Fischer & C. A. Meyer includes seven species (*O. alboroseum* Fischer & C. A. Meyer, *O. caerulescens* Boissier, *O. dasytrichum* Boisser, *O. hebebulbum*, *O. latifolium* Boissier, *O. qandilicum* Rechinger f. & Riedl, and *O. rascheyanum* Boissier), which share the following characters in common: a glabrous nectariferous annulus (except *O. qandilicum*, which is villous), the presence of rosette leaves of sterile branches, basal spatulate leaves, stellate hairs at the base of the setae, the presence of short hairs

between setae, an appressed or spreading indument covering the calyx and bracts, and corolla length (16–30 mm).

Onosma bisotunensis is a rare species. Its distribution is very narrow, and we found only scattered bushes in the area.

Paratype. IRAN. **Kermanshah:** Kermanshah–Kamyaran rd., Tang-e Gharal, 1420–1500 m, 15 Apr. 2001, *Hamzeh'ee & Asri 80843* (TARI).

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Three New Species of *Davilla* (Dilleniaceae) from Brazil

Gerardo A. Aymard C.

UNELLEZ-Guanare, Programa de R. N. R., Herbario Universitario (PORT), Mesa de Cavacas, Estado Portuguesa, Venezuela 3350. gaymard@cantv.net

Abstract. Three new species of *Davilla* Vandelli from Amazonas, Bahia, and Pará states, Brazil, are described and illustrated. *Davilla bahiana* Aymard resembles *D. cuspidulata* Martius but mostly differs by its leaves coriaceous, papillate on the upper surface, with lateral nerves 11 to 19, and carpels strigose at the apex. *Davilla bilobata* Aymard is related to *D. grandifolia* Moricand but can be distinguished by its tertiary nerves deeply areolate on the lower surface, inflorescence shorter (to ca. 5.5 cm), the shape and pubescence of the sepals, and the petals bilobed. *Davilla neei* Aymard was collected inside the study plots of the Biological Dynamics of Forest Fragments Project in central Amazonian lowland forest; it is similar to *D. kunthii* St. Hilaire but differs by its wider leaves (7–)15 cm long, the margins coarsely serrate, short inflorescences (only 10–11 cm long), and carpels densely hispid-incanous. *Davilla bilobata* is a distinctive species for its bilobed petals in a genus with otherwise predominantly entire petals.

Key words: Bilobed petals, Brazil, *Davilla*, Dilleniaceae, IUCN Red List, section *Davilla*, section *Homalochlaena*.

Davilla Vandelli (Dilleniaceae) is a genus of 30 to 40 species native to the Neotropics (Kubitzki, 1971; Aymard, 1998). Species are lianas, vines, or erect or scandent shrubs with sepals unequal in size, the two inner sepals larger, becoming crustaceous and covering the fruit completely when mature, the inflorescence paniculate, and the fruit a capsule. The genus was revised by Kubitzki (1971), and a key to Brazilian species of *Davilla* was recently prepared by Aymard (2002). The following species were discovered during herbarium studies over the past several years by the author and add to the diversity of species of Dilleniaceae in the Brazilian flora, especially in central Amazonian and Bahian forests.

1. Davilla bahiana Aymard, sp. nov. TYPE: Brazil. Bahia: Santa Cruz de Cabrália, Km 25.6 da Rodovia BR 367 (Eunápolis–Porto Seguro), 150 m, 4 June 1979, *S. A. Mori, R. M. King & A. M. de Carvalho 12006* (holotype, CEPEC; isotypes, NY, PORT, US). Figure 1.

Species *Davillae cuspidatae* Martius accedens, sed diversa ramis ramulisque brunneis, foliis coriaceis 7–15 cm longis, supra papillatis, apice acutis, nervis lateralibus 11 ad 19, petiolis 1–2.5 cm × 3–6 mm, dense adpresse ferrugineo-pubescentibus, sepalis interioribus extus haud papillatis, carpellis apice strigosis.

Woody vine, branches and branchlets brown, covered by long ferruginous-patent trichomes, 1.5–3 mm, glabrescent when mature. Leaf blades coriaceous, 7–15 × 3–6 cm, elliptic or elliptic-obovate, base obtuse, apex acute, margins subrevolute, entire, smooth on both surfaces, sparsely pilose (glabrescent when mature) and papillate on the upper surface, densely patent-pilose along the midrib and secondary nerves on the lower surface, with trichomes ferruginous and spreading, lateral nerves 11 to 19, convergent and anastomosing close to the margin; petioles winged, canaliculate, 1–2.5 cm × 3–6 mm, densely adpressed ferruginous-pubescent. Inflorescence 8–16 cm, peduncle and pedicels patent-ferruginous strigose, pedicels 4–10 mm. Sepals 5, quincuncial, orbicular, the outer 3, 3–6 mm, not papillate, lax sparsely strigose to glabrescent externally, glabrous internally, margins ciliate, the inner 2, 0.8–1.2 cm, glabrous on both surfaces, papyraceous when mature, petals not seen; stamens 80 to 100, filaments ca. 4 mm, glabrous, anthers ca. 0.8 mm, glabrous; carpels 2, glabrous, strigose apically, style ca. 3 mm, glabrous, stigma capitate. Seeds 1 per carpel, 4–5 mm, glabrous, brown, aril white, completely covering the seed.

Distribution and habitat. *Davilla bahiana* is known only from the type locality, in Bahia state, Brazil, where it has been collected in moist forests locally known as "Mata Higrófila Bahiana."

IUCN Red List category. The type locality of this new species is the unprotected Bahian forests; therefore, using the IUCN Red List criteria (IUCN, 2001), this species should be included in the category VU (Vulnerable). However, the precise conservation status of the population(s) has not been determined because this species is only known by a single collection.

Relationships. Because its internal sepals overlap, *Davilla bahiana* belongs to section *Davilla* Vandelli

Figure 1. *Davilla bahiana* Aymard. —A. Branch with leaves and inflorescences. —B. Flower with an internal sepal removed showing the stamens and the carpels. —C. Abaxial leaf pubescence. Drawn from the holotype, *S. A. Mori, R. M. King & A. M. de Carvalho 12006* (CEPEC).

(Kubitzki, 1971). By its branches, branchlets, pubescence along the blade/leaf midrib and secondary nerves on the lower surface, and inflorescences and pedicels covered by patent-ferruginous trichomes, this new species is similar to *D. cuspidulata* Martius. However, *D. bahiana* is distinguished from the latter by its branches and branchlets brown; leaves coriaceous, 7–15 cm long, papillate on the upper

surface, apex acute, lateral nerves 11 to 19; petioles 1–2.5 cm × 3–6 mm, densely ferruginous-pubescent; internal sepals not papillate externally; and carpels strigose at the apex. On the other hand, *D. cuspidulata* has branches and branchlets gray; leaves chartaceous to subcoriaceous, 5–8 cm long, not papillate on the upper surface, apex cuspidate, lateral nerves 8 to 10; petioles 0.4–1.5 cm × 0.5–2 mm, sparsely strigose; internal sepals papillate externally; and carpels completely glabrous.

In Aymard (2002), this species was treated as "*Davilla* sp. A."

2. Davilla bilobata Aymard, sp. nov. TYPE: Brazil. Bahia: Porto Seguro, Reserva da Brasil/Holanda, Km 22 rd. Eunapális to Porto Seguro, 16°27′S, 39°19′W, 6 Apr. 1994, *A. M. V de Carvalho, A. M. Amorin, S. C. Sant'Ana & J. G. Jardim 4463* (holotype, CEPEC; isotypes, NY, PORT). Figure 2.

Species *Davillae grandifoliae* Moricand proxima, sed differt foliis basi acutis, nervis tertiariis subtus profunde areolatis, inflorescentia ca. 5.5 cm longa, sepalis orbicularibus extus dense adpresse luteo-pubescentibus, petalis 5, obcordatis, bilobis, staminibus ca. 3 mm longis.

Woody vine, branches and branchlets adpressed-pubescent, glabrescent, striate, the bark flaking off when mature. Leaves coriaceous, 10–20 × 5–15 cm, elliptic to elliptic-ovate, base acute, apex rounded, shortly acuminate, margins entire or subsinuate, revolute, smooth and sparsely adpressed-pilose on the upper surface, patent-pilose on the lower surface, densely adpressed-pubescent along the midrib and secondary nerves, lateral nerves 15 to 19, straight to the margin, impressed on the upper surface, elevated, tertiary nerves deeply areolate on the lower surface; petioles robust, thick at the base, 1.5–3.5 cm × ca. 5 mm, subalate, densely adpressed-pubescent. Inflorescence ca. 5.5 cm, rachis, bracteoles, and pedicels densely adpressed yellow-pilose, bracteoles ca. 5 mm, lanceolate, glabrous internally, pedicels 5–10 mm. Sepals 5, unequal, orbicular, outer 3, 5–7 mm, densely adpressed yellow-pubescent externally, glabrous internally, ciliate at the margins, the inner 2, 9–11 mm; petals 5, equal, yellow, imbricate, obcordate, glabrous on both surfaces, ca. 10 mm, bilobed, lobes 3–4 mm. Stamens 120 to 150, filaments ca. 3 mm, glabrous, anthers 0.2–0.3 mm, glabrous; carpels 2, ca. 2 mm, glabrous, style ca. 4 mm, glabrous, stigma capitate. Seeds and fruit not seen.

Distribution and habitat. According to the specimen label, this species is found in the moist Brazilian forest locally called "Mata Higrófila Sul Bahiana."

IUCN Red List category. Using the IUCN Red List criteria (IUCN, 2001), this species should be included in the category VU (Vulnerable). However, the precise conservation status of the population(s) has not been determined because this species is only known by a single collection.

Relationships. By the internal sepals not imbricate and pressed against each other, *Davilla bilobata* belongs to section *Homalochlaena* Kubitzki (Kubitzki, 1971). By its larger leaves with margins entire or subsinuate and its numerous stamens (120 to 150), this new species appears to be related to *D. grandifolia* Moricand. However, *D. bilobata* differs from the latter by its leaves with tertiary nerves deeply areolate on the lower surface and base acute (vs. tertiary nerves not areolate, blade base rounded or subcordate); inflorescence ca. 5.5 cm long (vs. inflorescence 10–35 cm); sepals orbicular, densely adpressed yellow-pubescent externally (vs. sepals suborbicular, incanous or ferruginous-sericeous pubescent externally); petals 5, obcordate, bilobed (vs. petals 3, obovate-oblong, entire); and stamens ca. 3 mm long (vs. stamens 5–6 mm).

This is the first known species of genus *Davilla* with petals lobulate.

3. Davilla neei Aymard, sp. nov. TYPE. Brazil. Amazonas: Manaus, Rodovia BR 174, Km 64, 23 km E on ZF3, Fazenda Esteio, "Projeto Dinâmica Biológica de Fragmentos," 02°24′S, 59°52′W, 29 Jan. 1992, *M. Nee 42366* (holotype, INPA; isotypes, NY, PORT, US). Figure 3.

Species *Davillae kunthii* St. Hilaire propinqua, sed divergens foliis 7–15 cm latis, e late ovato orbicularibus, margine grosse serratis, petiolis 5–6 mm latis, dense adpresse incano-pubescentibus, inflorescentia 10–11 cm longa, sepalis interioribus e late ovato orbicularibus, 3–4 mm longis, petalis 3 ad 4, ovatis, filamentis 2–3 mm longis, carpello dense hispido-incano.

Woody vine, branches and branchlets brownish, densely adpressed incanous-ferruginous, glabrescent, striate, the bark flaking off when mature. Leaf blades coriaceous, 12–20 × 7–15 cm, ovate, broadly ovate to orbicular, base rounded, apex rounded, shortly acuminate, margins revolute, coarsely serrate, more so in the upper half of the blades, scabrous to verrucose, sparsely pilose, adpressed-pubescent along the midrib and secondary nerves on the upper surface, sparsely ferruginous-pubescent, densely yellow-ferruginous adpressed-pubescent along the midrib, secondary, and tertiary nerves on the lower blade surface, lateral nerves 15 to 18, convergent and linking to the margin, impressed on the upper surface, elevated on the lower surface, tertiary venation areolate on the lower blade

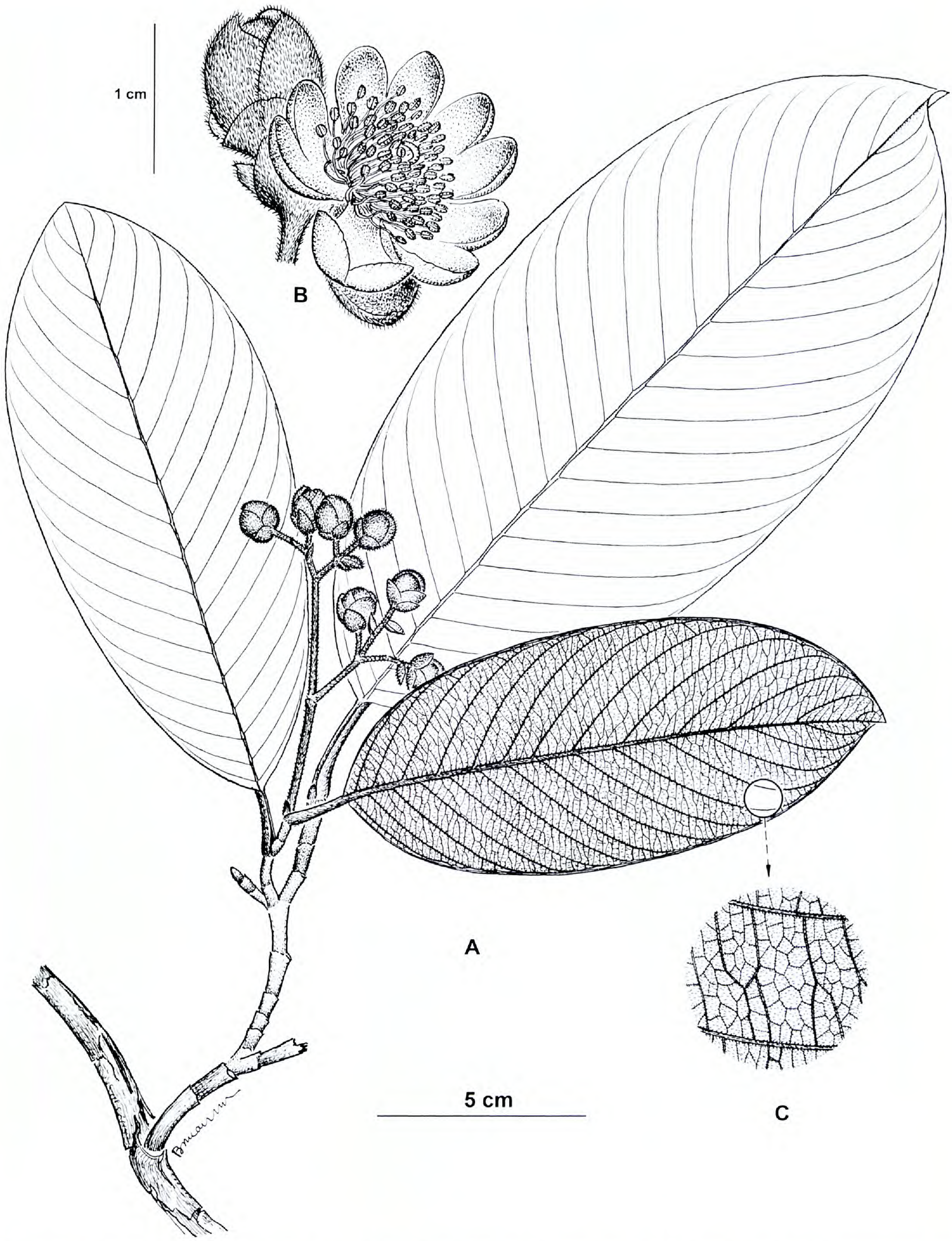

Figure 2. *Davilla bilobata* Aymard. —A. Branch with leaves and inflorescences. —B. Flower showing the stamens and the bilobed petals. —C. Detail of the abaxial leaf. Drawn from the holotype, *A. M. V de Carvalho, A. M. Amorin, S. C. Sant'Ana & J. G. Jardim 4463* (CEPEC).

surface; petioles robust, thick at the base, 1.5–3 cm × 5–6 mm, subalate, densely adpressed incanous-pubescent. Inflorescence 10–11 cm, rachis densely adpressed ferruginous-tomentose, bracteoles 4–6 mm, lanceolate or ovate, densely adpressed-ferruginous externally, glabrous internally, pedicels 3–6 mm. Sepals 5, adpressed sericeous-pubescent externally, glabrous internally, ciliate at the margins, the outer 3

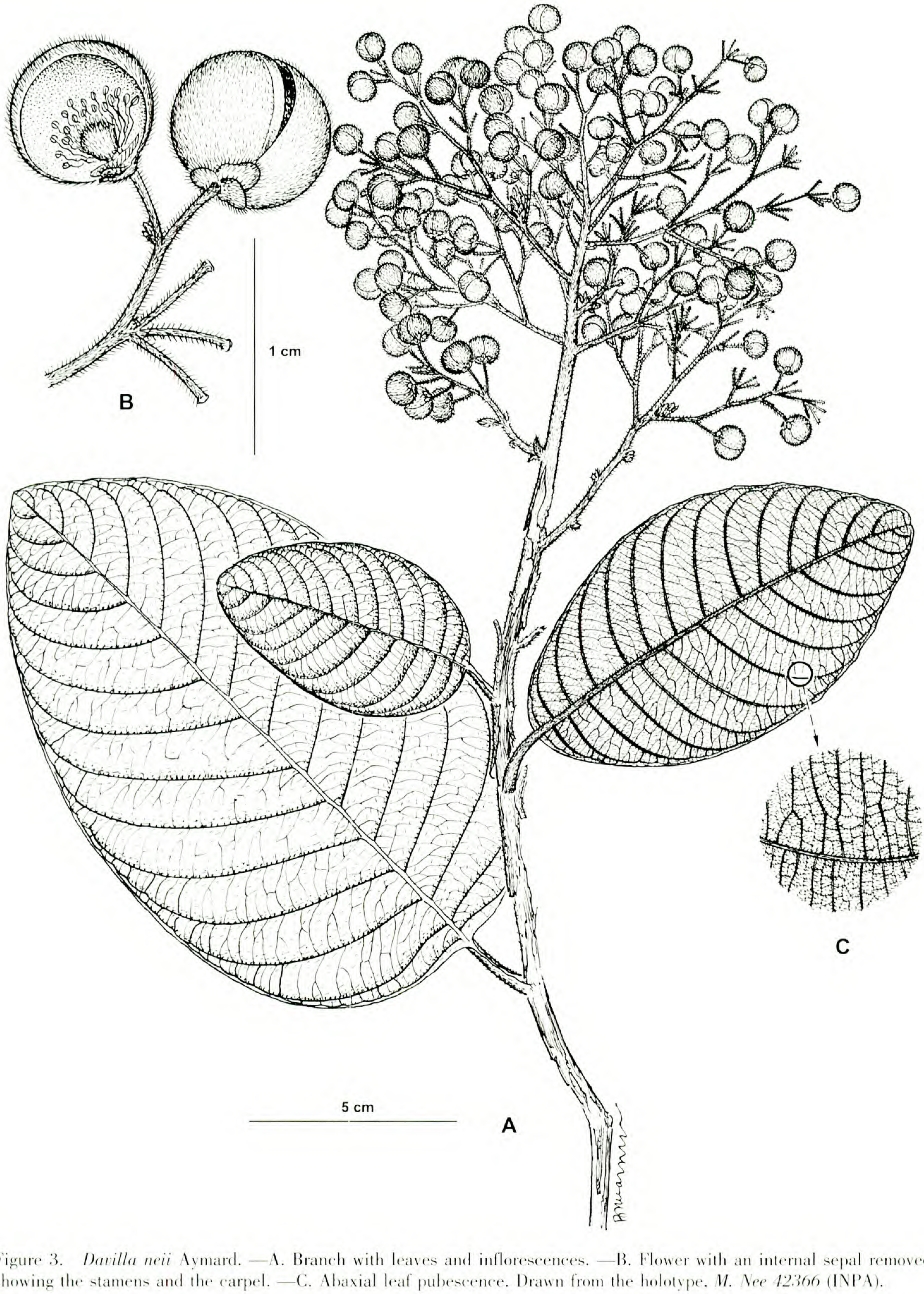

Figure 3. *Davilla neii* Aymard. —A. Branch with leaves and inflorescences. —B. Flower with an internal sepal removed showing the stamens and the carpel. —C. Abaxial leaf pubescence. Drawn from the holotype, *M. Nee 42366* (INPA).

orbicular, 1–2 mm, the inner 2 broadly ovate to orbicular, 3–4 × ca. 8 mm, papyraceous when mature; petals 3 to 4, yellow, ovate, glabrous on both surfaces, 3–4 mm. Stamens 50 to 60, filaments 2–3 mm, glabrous, anthers 0.2–0.3 mm, glabrous; carpel 1, ca. 2 mm, densely hispid to incanous-pubescent, style ca. 3 mm, glabrous, stigma capitate. Fruit and seeds not seen.

Distribution and habitat. *Davilla neei* is distributed very locally in central Amazonian lowland forest, in Amazonas and Para states, Brazil, where it is a characteristic liana in the canopy trees in the study site of the Biological Dynamics of Forest Fragments Project, a collaborative project developed between the National Institute for Amazonian Research (INPA) and the World Wildlife Fund that assesses the effect of reduction in rainforest area on biological diversity, particularly on the number of species of plants and animals in remnant patches (Bierregaard Jr. & Gascon, 2001; Laurance, 2001).

IUCN Red List category. Although this new species has been collected many times, this taxon should be included in the category VU (Vulnerable) according to IUCN Red List criteria (IUCN, 2001) because it is located in the central Amazonian forests, a widely deforested region. However, the precise conservation status of the population(s) has not been determined.

Relationships. By its petioles, midribs, and lateral veins on the lower leaf blade adpressed-pubescent, with trichomes white or brown, *Davilla neei* is most similar to *D. kunthii* St. Hilaire in section *Davilla*. However, this new species differs principally by the leaves 7–15 cm wide, broadly ovate to orbicular, the margins coarsely serrate; petioles 5–6 mm wide, densely adpressed incanous-pubescent; inflorescence 10–11 cm long; the inner sepals broadly ovate to orbicular, 3–4 mm long; petals 3–4 mm long, ovate; filaments 2–3 mm long; and the carpel densely hispid-incanous. In contrast, *D. kunthii* has leaves only 2–9 cm wide, elliptic to suborbicular, sometimes lanceolate, margins entire or dentate; petioles 2–4 mm wide, adpressed white-pubescent; inflorescence 10–25 cm long; inner sepals elliptic, 4–6 mm long; petals 4–6 mm long, obovate; filaments 4–5 mm long; and the carpel glabrous, rarely sparsely pilose.

In Aymard (2002), this species was treated as "*Davilla* sp. B."

Etymology. The specific epithet honors the collector of the type, Michael Nee, noted authority on the Solanaceae and the Neotropical flora.

Paratypes. BRAZIL. **Amazonas:** Manaus, Rodovia BR 174, Km 64, 23 km E on ZF3, Fazenda Esteio, Projeto Dinâmica Biológica de Fragmentos, *M. Nee 42366* (INPA, NY, PORT, US); Reserva 1501 (Km 41) of the WWF/INPA MCS project, *S. A. Mori & M. Wong 19813* (MO, NY, PORT). **Pará:** Macau, Rio Maicuru, 300 m, *J. J. Strudwick et al. 3459* (NY, PORT).

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Two New Species of *Doliocarpus* (Dilleniaceae) from Colombia

Gerardo A. Aymard C.

UNELLEZ-Guanare, Programa de R. N. R., Herbario Universitario (PORT), Mesa de Cavacas, Estado Portuguesa, Venezuela 3350. gaymard@cantv.net

Abstract. *Doliocarpus schultesianus* Aymard from moist forests in the upper Río Negro region (Vaupés department) and *D. triananus* Aymard from montane forests in Antioquia department, Colombia, are described, illustrated, and compared to their closely related species. *Doliocarpus schultesianus* is not evidently allied to any other *Doliocarpus* Rolander species; this new species has inflorescences produced from short shoots (brachyblasts) and young fruit completely covered by stinging yellow trichomes. *Doliocarpus triananus* is most similar to *D. pipolyi* Aymard due its chartaceous leaves with margins dentate along the blade and its papyraceous basal bracteoles, but it differs from that species in its leaf and sepal shape, dense pubescence along the midrib and secondary nerves on the lower surface, peduncle patent-pilose, and fruit 10–12 mm in diameter, completely covered by white trichomes. An updated key to the 19 species of *Doliocarpus* from Colombia is provided.

Resumen. *Doliocarpus schultesianus* Aymard de bosques húmedos de la región del alto río Negro (departamento de Vaupés) y *D. triananus* Aymard de bosques montanos del departamento de Antioquia, Colombia, son descritas, ilustradas y comparadas con sus especies afines. *Doliocarpus schultesianus* no se relaciona con ninguna especies de *Doliocarpus* Rolander en particular; esta nueva especie posee inflorescencias dispuestas en los entre nudos muy cortos (braquiblastos) y frutos jóvenes completamente cubiertos por tricomas urticantes de color amarillo. Por sus hojas cartáceas, márgenes dentados a lo largo de la lámina y bractéolas básales papiráceas *D. triananus* es similar a *D. pipolyi* Aymard, sin embargo difiere de esta especie en la forma de las hojas y sépalos, pubescencia muy densa en el nervio central y nervios secundarios por el envés, pedúnculos patentes pilosos y frutos 10–12 mm en diámetro, completamente cubierto por tricomas blancos. Se presenta una clave actualizada de las 19 especies de *Doliocarpus* registradas de Colombia.

Key words: Catalogue of Vascular Plants of the Department of Antioquia, Colombia, Dilleniaceae, *Doliocarpus*, IUCN Red List, R. E. Schultes.

Doliocarpus Rolander includes about 50 species distributed throughout southern Mexico, Central America, the Antilles, the Guianas, Venezuela, Colombia, Ecuador, Peru, Bolivia, Brazil, and Paraguay (Aymard, 1998). Most *Doliocarpus* species are lianas (rarely shrubs), and within Dilleniaceae the genus is easily distinguished by having the inflorescences ramiflorous, fasciculate or glomerate; the ovary unicarpellate, 1-celled; the fruit a berry, sometimes opening irregularly; and seeds completely covered by a white aril. Kubitzki (1971) divided the genus into two sections: section *Calinea* Eichler, characterized by having leaves with tertiary nerves subparallel (rarely reticulate), filaments erect-flexuose with anthers introrse at anthesis, and ovary glabrous or pilose, and section *Doliocarpus* Rolander having leaves with tertiary nerves reticulate, filaments reflexed with anthers extrorse at anthesis, and the ovary pilose. Examination of hundreds of *Doliocarpus* herbarium specimens during the past 25 years demonstrates that a small percentage of specimens were found with flowers in anthesis. In addition, most specimens are in young fruit with the stamens and the sepals persistent and lacking petals. Although these character states are useful, they are unreliable to use as two of the main features to divide the genus. Thus, leaf venation may be the most taxonomically useful character to separate the two sections of this genus.

This publication increases the number of *Doliocarpus* species known from Colombia to 19. *Doliocarpus triananus* Aymard was discovered during the preparation of the Dilleniaceae treatment for the Catalogue of Vascular Plants of the Department of Antioquia (being carried out by the Missouri Botanical Garden and the Universidad de Antioquia), and *D. schultesianus* Aymard was discovered from an unidentified specimen at GH collected by R. E. Schultes.

1. **Doliocarpus schultesianus** Aymard, sp. nov. TYPE: Colombia. Vaupés: Río Vaupés, raudal Dr. Tatú, Mitú vic., 27 Sep.–20 Oct. 1966, *R. E. Schultes, R. F. Raffaul & D. D. Soejarto 24378* (holotype, GH; isotype, PORT). Figure 1.

Scandens, ramis ramulisque glabris. Folia elliptica, 7–12 × 4–7 cm, rigido-coriacea, basi acuta, apice acuminata, margine subrevoluta, dentata, supra pagina sparse pilosa sed costa nervisque secundariis trichomatibus luteis densis

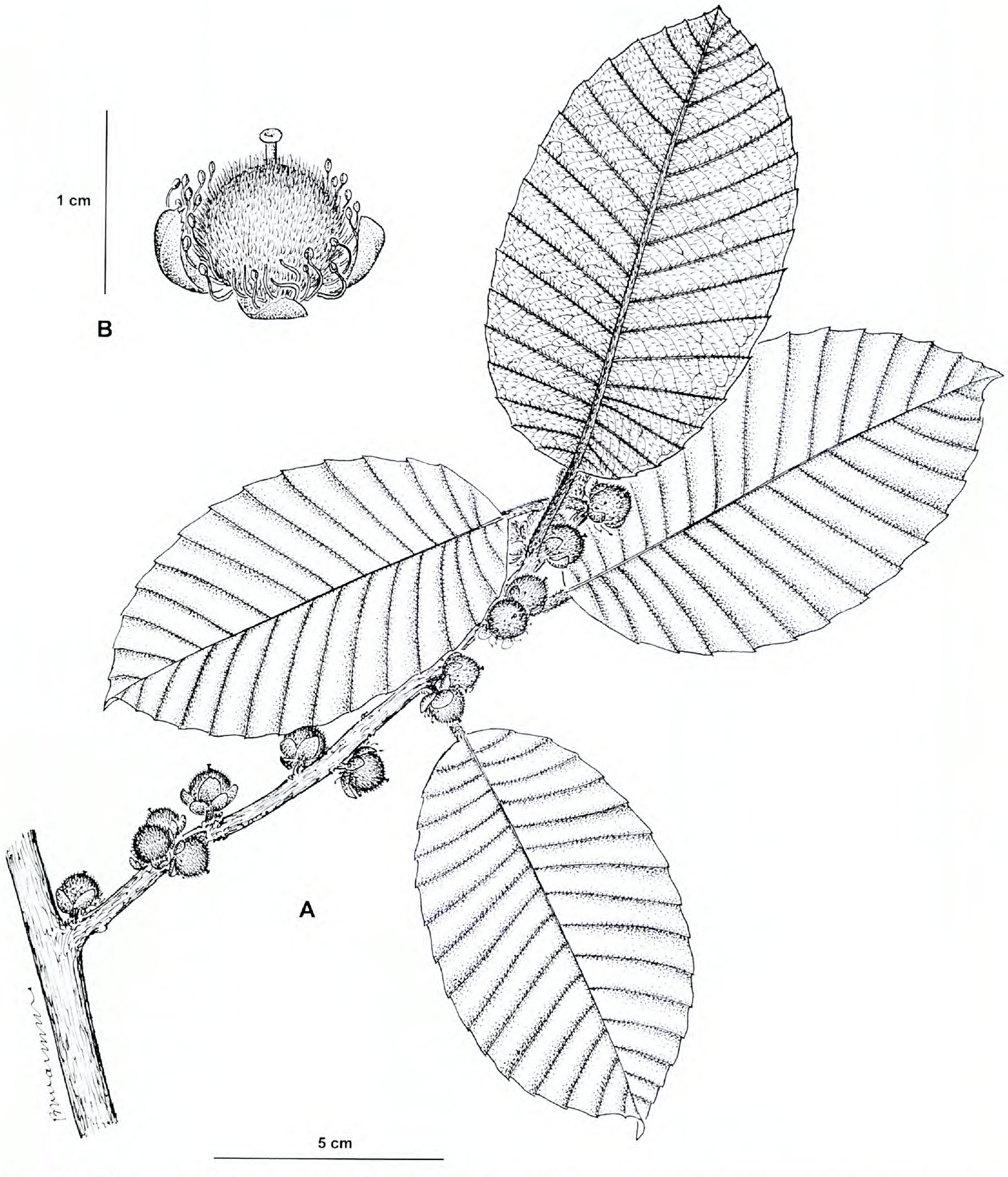

Figure 1. *Doliocarpus schultesianus* Aymard. —A. Flowering branchlet. —B. Flower with a young fruit. Drawn from the holotype, *R. E. Schultes, R. F. Raffaul & D. D. Soejarto 24378* (GH).

adpressis praeditis, subtus pagina dense pubescenti (trichomatibus erectis ca. 1 mm longis), secus costam nervosque secundarios densius pubescenti, demum maturitate glabrescenti; nervis lateralibus 15 ad 17, recte ad marginem tendentibus, supra impressis, subtus elevatis; petiolis 1.5–2.2 cm longis, dense luteo-pubescentibus. Inflorescentia axillaris, glomerata, subsessilis, pedunculo ca. 2 mm longo, dense adpresse pubescenti, 2 bracteolis basalibus, ca. 2 mm longis, extus adpresse sericeis, intus glabris praedito. Sepala 5, 3–7 mm longa, inaequalia (internis obovatis, exterioribus ovatis), extus adpresse sericea, intus sparse adpresse pilosa maturitate glabrescentia, margine ciliata. Stamina 50 ad 60, ca. 2.5 mm longa, filamentis glabris, antheris oblongis. Ovarium trichomatibus luteis urentibus, 1–1.5 mm longis opertum. Stylus glaber, 1–2 mm longus, stigmate capitato. Fructus dense luteo-hispidus, 5–8 mm diametro. Semina nigra, reniformia, 3–4 mm longa, 1 in quoque fructu, arillo integro semen operiente.

Liana, branches and branchlets glabrous, bark flaking off when mature. Leaves elliptic, 7–12 × 4–7 cm, rigid-coriaceous, base acute, apex acumi-

nate, acumen ca. 5 mm, margins subrevolute, dentate, sparsely pilose on the upper surface, except along the midrib and secondary nerves, where densely covered by adpressed yellow trichomes, densely pubescent (erect trichomes, ca. 1 mm) on the lower surface, most dense along the midrib and secondary nerves, becoming glabrescent when mature; lateral blade nerves 15 to 17, straight at the margin (craspedodromous venation), impressed on the upper surface, elevated on the lower surface, tertiary venation subparallel; petioles 1.5–2.2 cm, exalate, densely yellow-pubescent. Inflorescences produced from short shoots (brachyblasts), axillary, glomerate, subsessile, penducle ca. 2 mm, densely adpressed-pubescent, with 2 basal bracteoles, ca. 2 mm, adpressed-sericeous externally, glabrous internally. Sepals 5, 3–7 mm, unequal (internal obovate, external ovate) adpressed-sericeous externally, sparsely adpressed-pilose internally to glabrescent when mature, ciliate at the margins; petals not seen; stamens 50 to 60, ca. 2.5 mm, filaments glabrous, anthers oblong; ovary and young fruit completely covered by stinging yellow trichomes (1–1.5 mm), style glabrous, 1–2 mm, stigma capitate. Immature fruit densely covered by stinging yellow trichomes 5–8 mm diam.; seed black, reniform, 3–4 mm, 1 per fruit, aril white, entire, completely covering the seed.

Habitat and distribution. *Doliocarpus schultesianus* is known only from the type collection, collected in moist forest in the upper Río Negro basin.

IUCN Red List category. The type locality of this new species is the remote forests of the upper Río Negro region, Colombia; therefore, using the IUCN Red List criteria (IUCN, 2001), this species should be included in the category LC (Least Concern). However, the conservation status of the population(s) has not been determined because this species is only known by a single collection.

Relationships. Because of its tertiary subparallel venation, *Doliocarpus schultesianus* belongs to the section *Calinea* (sensu Kubitzki, 1971). This new species is not apparently allied to any other species in the section. It is similar to *D. macrocarpus* Martius ex Eichler, especially in its inflorescences not racemose and produced from short shoots (brachyblasts). However, *D. schultesianus* differs from the latter in its leaves elliptic, rigid-coriaceous, with margins serrate and dense pubescence on the lower surface; peduncle ca. 2 mm long, densely adpressed-pubescent; sepals ciliate at the margins; and fruit completely covered by stinging yellow trichomes and one-seeded. By contrast, *D. macrocarpus* has subcoriaceous to coriaceous leaves, obovate or obovate-elliptic, with margins entire or sinuate-serrulate, and tomentulose on the lower surface; peduncle 2–7 mm long, tomentulose; sepals not ciliate at the margins; and fruit sparsely adpressed-pilose (trichomes white) and two-seeded.

Etymology. The specific epithet honors the collector of the type, Richard Evans Schultes (1915–2001), distinguished authority on tropical vegetation. Dr. Schultes, best known as the father of ethnobotany (Davis, 2004), researched the use of plants by indigenous cultures for more than 40 years; he held strong conservative political beliefs and was always a staunch believer in individual freedom (Fire, 2001).

2. Doliocarpus trianaus Aymard, sp. nov. TYPE: Colombia. Antioquia: Amalfí, Vereda "La Gloria," 35–37 km NE de Amalfí, vía Amalfí–Vetilla, 07°05′N, 74°56′W, 950–1100 m, 9 Dec. 1989, *R. Callejas, J. Betancur & O. Escobar 9222* (holotype, HUA; isotypes, MO, NY, PORT). Figure 2.

Doliocarpo pipolyi Aymard affinis, sed diversus foliis ellipticis basi cuneatis, subtus costa nervisque secundariis dense pubescentibus, pedunculo patenti-piloso, sepalis ovatis, fructu 10–12 mm diametro hispido-piloso.

Liana, branches and branchlets pilose, becoming glabrescent when mature, bark flaking off. Leaves elliptic, 5–13 × 3–6 cm, chartaceous, base cuneate, apex acuminate, acumen ca. 5 mm, margins dentate along the blade, glabrous on the upper surface, except along the midrib, where covered by erect trichomes, sparsely pilose on the lower surface, densely pubescent along the midrib and secondary nerves; lateral nerves 10 to 17, terminating at the margin (craspedodromous venation), elevated on the lower surface, impressed on the upper surface, tertiary venation subparallel; petioles 5–10 mm, exalate, patent-pilose. Inflorescence axillary, in fascicles, not racemose, peduncles 8–16 mm, patent-pilose; with 3 basal bracteoles, papyraceous, ca. 3 mm, densely pubescent externally, glabrous internally; sepals 4, unequal, ovate, external 3–4 mm, internal 5–6 mm, adpressed-sericeous externally, glabrous internally; petals not seen; stamens ca. 80; filaments 3–4 mm, glabrous; ovary densely hispid-tomentose, covered by yellow trichomes, style glabrous, ca. 2 mm, stigma capitate. Fruit red, 10–12 mm diam., completely covered by white hispid-pilose trichomes (ca. 2 mm); seed black, reniform, ca. 7 mm, 1 per fruit, aril white, entire, completely covering the seed.

Distribution and habitat. *Doliocarpus trianaus* is known only from the type and paratype collections, collected in montane forest in Antioquia department, Colombia.

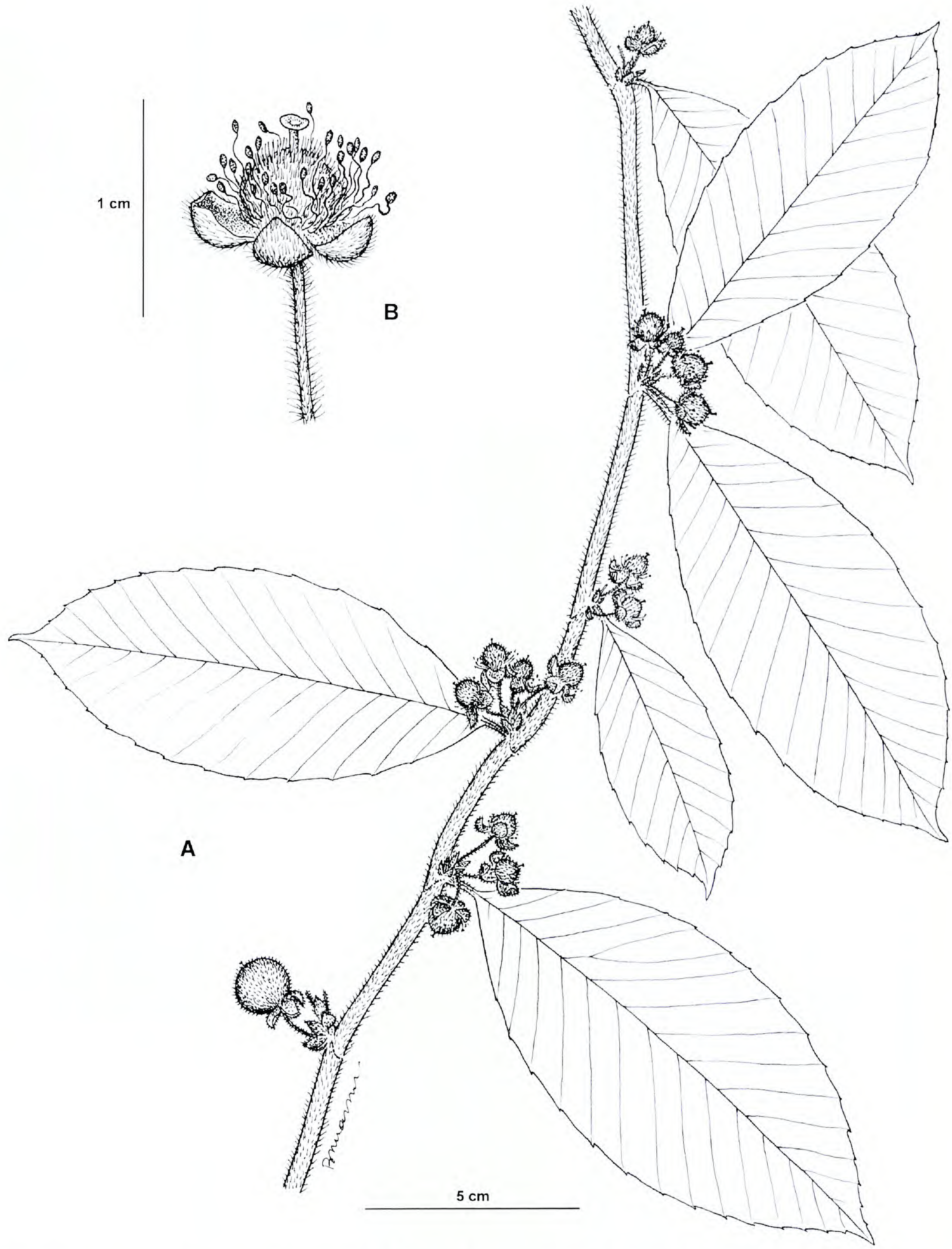

Figure 2. *Doliocarpus triananus* Aymard. —A. Flowering branchlet. —B. Flower with a young fruit. Drawn from the holotype, *R. Callejas, J. Betancur & O. Escobar 9222* (HUA).

IUCN Red List category. This new species is only known from montane forests in the Colombian Andes; therefore, using the IUCN Red List criteria (IUCN, 2001), this species should be included in the category VU (Vulnerable). However, the conservation status of the population(s) has not been determined.

Relationships. Because of its tertiary subparallel venation, *Doliocarpus trianaus* belongs to section *Calinea* (sensu Kubitzki, 1971). By its chartaceous leaves with dentate margins and papyraceous basal bracteoles, this new species is most similar to *D. pipolyi* Aymard, which is known only from Amazonian moist forests, Loreto department, Peru (Aymard, 1993). However, this new species differs from the latter in its elliptic leaves with cuneate base, dense pubescence along the midrib and secondary nerves on the lower surface; the peduncle patent-pilose; sepals ovate; and the fruit 10–12 mm in diameter, completely hispid-pilose. In contrast, *D. pipolyi* has leaves obovate to oblanceolate with base attenuate, sparsely pilose to glabrescent along the midrib and secondary nerves on the lower blade surface; peduncle adpressed-pubescent; sepals ovate-elliptic; and fruit 6–8 mm in diameter, only sparsely pilose to glabrescent when mature.

The *Callejas et al. 9222* type specimen was previously referred to *Doliocarpus hispidus* Standley & L. O. Williams (Aymard, 1997). However, *D. hispidus* differs from the new species in its leaves broadly elliptic to elliptic-obovate, 10–21 cm long, base cuneate (vs. leaves elliptic, 5–13 cm, base attenuate); margins in the upper half of the leaf blade dentate (vs. margins dentate along the blade); petiole ca. 15 mm long (vs. petiole 5–10 mm); peduncles ca. 10 mm long, with 2 coriaceous bracteoles (vs. peduncles 8–16 cm, with 3 papyraceous bracteoles); sepals broadly ovate to suborbicular, densely yellow hispid-pubescent externally (vs. sepals ovate, adpressed-sericeous externally); and fruit covered by yellow trichomes (vs. fruit covered by white trichomes).

Etymology. This species is named in honor of José Jéronimo Triana (1828–1890), notable Colombian journalist and botanist. Throughout his participation in the Colombian Chorographic Commission ("Comisión Corográfica") from 1851 to 1857, he explored the Colombian territory and collected nearly 4000 invaluable specimens (Dugand, 1944). Working on his *Flora Colombiana*, J. J. Triana was the first Latin American botanist to study the Dilleniaceae (Triana, 1858; Triana & Planchón, 1862).

Paratype. COLOMBIA. **Antioquia:** Amalfí, Vereda "Arenas Blancas," 1100–1250 m, 11 Mar. 1994, *R. Fonnegra y grupo de Palinología (Sem. I/94) 4713* (HUA, MO, PORT).

Key to the Species of *Doliocarpus* in Colombia (Based on Aymard, 1997)

1. Tertiary venation reticulate; leaves with verrucosities on lower surface 2
1. Tertiary venation subparallel; leaves without verrucosities on lower surface. 4
2(1). Lateral nerves terminating at the margin; sepals glabrous externally; fruits covered by trichomes 3–5 mm long . . . . . *D. olivaceus* Sprague & R. O. Williams (Antioquia, Chocó)
2. Lateral nerves linking close to the margin; sepals adpressed-pilose externally; fruits covered by trichomes 5–10 mm long 3
3(2). Branches angulate; leaves shiny on the upper surface, glabrous on the lower surface; margins entire . . . . . *D. nitidus* (Triana) Triana & Planchón (Antioquia, Chocó, Ibagué, Tolima)
3. Branches terete; leaves dull on the upper surface, adpressed-pubescent on the lower surface; margins sinuate to dentate . . . . . *D. major* J. F. Gmelin subsp. *major* (Amazonas, Antioquia, Chocó)
4(1). Inflorescences with peduncles 0.5–7 mm long. . . 5
4. Inflorescences with peduncles longer than 10 mm 13
5(4). Inflorescences racemose (peduncle with 2 to 6 flowers) 6
5. Inflorescences not racemose (peduncle with a single flower). 7
6(5). Leaves conduplicate, rigid-coriaceous; margins in the upper half of the leaf blade entire; sepals obovate-elliptic. . . *D. spraguei* Cheesman (Vichada)
6. Leaves not conduplicate, subcoriaceous or coriaceous; margins in the upper half of leaf blade serrate; sepals ovate-elliptic . . . . . *D. brevipedicellatus* Garcke subsp. *brevipedicellatus* (Antioquia, Bolívar, Chocó, Córdoba, Guainía)
7(5). Leaves 2–4 cm wide, petiole 4–7 mm long; sepals oblong; fruit 4–6 mm diam . . . . . *D. chocoensis* Aymard (Chocó)
7. Leaves 4–15 cm wide, petiole 0.7–5 cm long; sepals obovate, ovate, elliptic, or obovate-elliptic; fruit 5–15 mm diam 8
8(7). Leaves 12–35 cm long 9
8. Leaves 5–12 cm long 10
9(8). Leaves black punctate on the lower surface; petiole 3–5 cm long; peduncle 4–7 mm long . . . . . *D. lopez-palacii* Aymard (Antioquia)
9. Leaves not black punctate on the lower surface; petiole 1.5–3 cm long; peduncle 0.5–1 mm long . . . . . *D. foreroi* Aymard (Chocó, Valle)
10(8). Leaves pilose on the upper surface 11
10. Leaves glabrous on the upper surface 12
11(10). Leaves elliptic, densely pubescent on the lower surface; peduncle ca. 2 mm long; sepals ciliate at the margins; fruit completely pubescent (covered by yellow stinging trichomes). . . . . *D. schultesianus* Aymard (Vaupés)
11. Leaves obovate or obovate-elliptic, tomentulose on the lower surface, peduncle 2–7 mm long; sepals not ciliate at the margins; fruit sparsely adpressed-pilose with white trichomes, not

stinging . . . . . *D. macrocarpus* Martius ex Eichler (Santander, Vaupés)

12(10). Leaves lanceolate or lanceolate-elliptic, coriaceous, the margins subrevolute; petioles 0.5–2 mm wide; sepals elliptic, 2–4.5 mm long, glabrous or sparsely pilose on the outside . . . . . *D. savannarum* Sandwith (Guainía, Vaupés)

12. Leaves elliptic or elliptic-oblong, rigid-coriaceous, the margins strongly revolute; petioles 3–4 mm wide; sepals ovate-elliptic, 5.5–6 mm long, adpressed-pilose on the outside . . . . . *D. liesneri* Aymard (Guainía)

13(4). Inflorescences racemose (peduncle with 2 to 10 flowers) 14

13. Inflorescences not racemose (peduncle with a single flower) 15

14(13). Leaves coriaceous, oblanceolate-obovate or lanceolate, the margins entire or subsinuate; sepals elliptic . . . . . *D. novogranatensis* Kubitzki (Amazonas, Chocó, Meta)

14. Leaves subcoriaceous, obovate-lanceolate, the margins dentate; sepals obovate or obovate-oblong. . . . . . *D. multiflorus* Standley (Antioquia, Chocó, Valle)

15(13). Sepals laxly pubescent to glabrescent on the outside; fruits glabrous 16

15. Sepals pilose to pubescent on the outside; fruits densely pubescent 19

16(15). Leaves 14–30 × 10–20 cm 17

16. Leaves 6–12 × 5–8 cm 18

17(16). Stems, petioles, and leaf blades glabrous or with sparse, non-ferruginous pubescence . . . . . *D. dentatus* (Aublet) Standley subsp. *latifolius* Kubitzki (Vaupés)

17. Stems, petioles, and leaf blades with spreading, ferruginous pubescence . . . . . *D. dentatus* (Aublet) Standley subsp. *ferrugineus* (Rusby) Kubitzki (Chocó)

18(16). Leaves coriaceous, the margins crenate mostly along the upper half of the blades . . . . . *D. dentatus* (Aublet) Standley subsp. *undulatus* (Eichler) Kubitzki (Caquetá, Vaupés)

18. Leaves chartaceous or subcoriaceous, the margins serrate mostly along the upper half of the blades . . . . . *D. dentatus* (Aublet) Standley subsp. *dentatus* (Bolívar, Boyacá, Chocó, Cesár, Magdalena, Meta)

19(15). Margins entire or subsinuate; petioles 3–4.5 cm long; sepals pubescent adaxially . . . *D. dasyanthus* Kubitzki subsp. *robustus* Aymard (Valle)

19. Margins dentate or sinuate-crenate; petioles 1–2.5 cm long; sepals glabrous adaxially. 20

20(19). Leaves obovate or obovate-elliptic, margins sinuate-crenate; peduncle adpressed-pubescent; fruits covered by short and long trichomes . . . . *D. hispidobaccatus* Aymard (Caqueta)

20. Leaves elliptic or elliptic-obovate, margins dentate; peduncle hispid; fruits covered by uniformly sized trichomes 21

21(20). Leaves 10–21 × 4–10 cm, base cuneate, margins in the upper half of the leaf blade dentate, petiole ca. 15 mm long; peduncles with 2 coriaceous bracteoles; sepals broadly ovate to suborbicular, densely yellow hispid-pubescent abaxially; fruit 9–10 mm diam., covered by yellow trichomes. . . . . *D. hispidus* Standley & L. O. Williams (Valle)

21. Leaves elliptic, 5–13 × 3–6 cm, base cuneate, margins dentate along the entire leaf blade, petiole 5–10 mm long; peduncles with 3 papyraceous bracteoles; sepals ovate, adpressed-sericeous abaxially; fruit 10–12 cm diam., covered by white trichomes . . . . . *D. trianaus* Aymard (Antioquia)

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Amaranthus hunzikeri (Amaranthaceae), a New Species from Northwestern Argentina

Néstor D. Bayón

Cátedra de Sistemática Vegetal, Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata, CC 31, 1900 La Plata, Argentina. nbayon@isis.unlp.edu.ar

Abstract. *Amaranthus hunzikeri* N. Bayón (Amaranthaceae), a new Argentinian species of subgenus *Albersia* (Kunth) Grenier & Godron from the Andes Mountains at altitudes above 3200 m, is described and illustrated. It resembles *A. cardenasianus* Hunziker, *A. squamulatus* (Andersson) B. L. Robinson, and *A. urceolatus* Bentham, but it differs by the prostrate or decumbent habit, spatulate leaves, and staminate flowers with three to five sepals. A key to the species in *Amaranthus* L. sect. *Pyxidium* Moquin-Tandon is included.

Key words: Amaranthaceae, *Amaranthus*, Argentina, IUCN Red List.

The genus *Amaranthus* L. s.l. (Amaranthaceae) is usually accepted today by most taxonomists, although it has been subject to different taxonomic interpretations and segregate genera have been recognized in the past like *Acanthochiton* Torrey, *Acnida* L., *Albersia* Kunth, *Amblogyna* Rafinesque, *Euxolus* Rafinesque, *Mengea* Schauer, *Sarratia* Moquin-Tandon, and *Scleropus* Schrader.

Until the 1980s, *Amaranthus* included 50 to 60 species (Ohwi, 1965; Townsend, 1974, 1980, 1985; Cronquist, 1981; Robertson, 1981; Eliasson, 1987), but the addition of new species in the past two decades has enlarged the genus from 65 to 75 species (Mosyakin & Robertson, 1996, 2003; Costea & DeMason, 2001; Costea et al., 2001a, b). This genus has its greatest diversity in tropical, subtropical, and warmer temperate regions of the world.

The new species belongs to *Amaranthus* subg. *Albersia* (Kunth) Grenier & Godron, being a monoecious, prostrate plant with a dichasia arranged in axillary clusters (Mosyakin & Robertson, 1996), and belongs specifically to section *Pyxidium* Moquin-Tandon, which is characterized by circumscissile fruits.

Amaranthus hunzikeri N. Bayón, sp. nov. TYPE: Argentina. Catamarca: Laguna Blanca, 14 Mar. 1989, 3200–3300 m, *A. R. Reca & D. E. Ramadori 17* (holotype, SI). Figure 1.

Monoicus; caulis prostratus aut decumbens, 3–14 cm longus, a basi ramosus. Lamina spathulata, in apice rotunda aut emarginata, 10–17 × 3–9 mm; petiolus 4–11 mm longus. Glomeruli florum in axillis foliorum; bracteae 0.9–1.3 mm, mucrone conspicuo instructae. Flos masculinus (2)3- ad 5-merus, 1.3–2 mm, staminibus (2)3 ad 4. Flos femineus 5-merus; sepala late spathulata, reflexa, basi incrassata, 1.7–2.5 × 1.4–2.5 mm. Fructus circumscissilis, operculo rugoso; semen rubro-fusca aut nigricans, magis minusve 0.9–1.3 × 0.50–0.55 mm.

Prostrate or decumbent monoecious herbs; stems branched at base, unbranched above, glabrous, slender, 3–14 cm, 0.2–0.3 cm thick at base. Leaves similar in length throughout, petioles 4–11 mm, shorter than the lamina; lamina spatulate, rarely elliptic or oblong, 10–17 × 3–9 mm, glabrous, light green, usually attenuate or sometimes cuneate basally, decurrent, rounded or emarginated apically with a mucro 0.5–1 mm, margins crisped, veins raised abaxially. Inflorescences whitish green, axillary in rounded clusters to 7 mm diam., or crowded in short leafy terminal spike-like inflorescence to 20 mm on short internodes; bracts and bracteoles deltoid, ovate, elliptic or orbicular, persistent, shorter than the sepals, 0.9–1.3 × 0.5–0.8 mm, whitish green and scarious-membranous, green along midvein, mucro 0.2–0.3 mm. Flowers of both sexes mixed; staminate flowers with (2)3 to 5 oblong, ovate to elliptic sepals, 1.3–2 mm, light brown with brown midvein, subacute to obtuse apex, scarious, stamens (2)3 to 4; pistillate flowers 2.2–3.3 × 2.5–4 mm distally, longer than mature fruit, urceolate with 5 sepals, tending to become swollen and joined 0.5 mm or less at base, broadly spatulate, 1.7–2.5 mm, lamina expanded 1.4–2.5 mm wide near tip, rounded, spongy and light brown basally, narrowed to 0.2–0.6 mm wide, overlapping and bent outward in upper half, scarious, sometimes notched apically, midvein profusely divided with many green branches, equal or one smaller than the rest; stigmas 3, narrow, 0.12–0.40 mm. Fruit circumscissile, 1.5–1.7 × 1.1–1.3 mm, light brown; lid rugose with curved ridges, furrows, and a conspicuous line of dehiscence above the middle part of the fruit; body smooth below the line; seed lenticular, reddish brown to blackish brown, 0.9–1.3

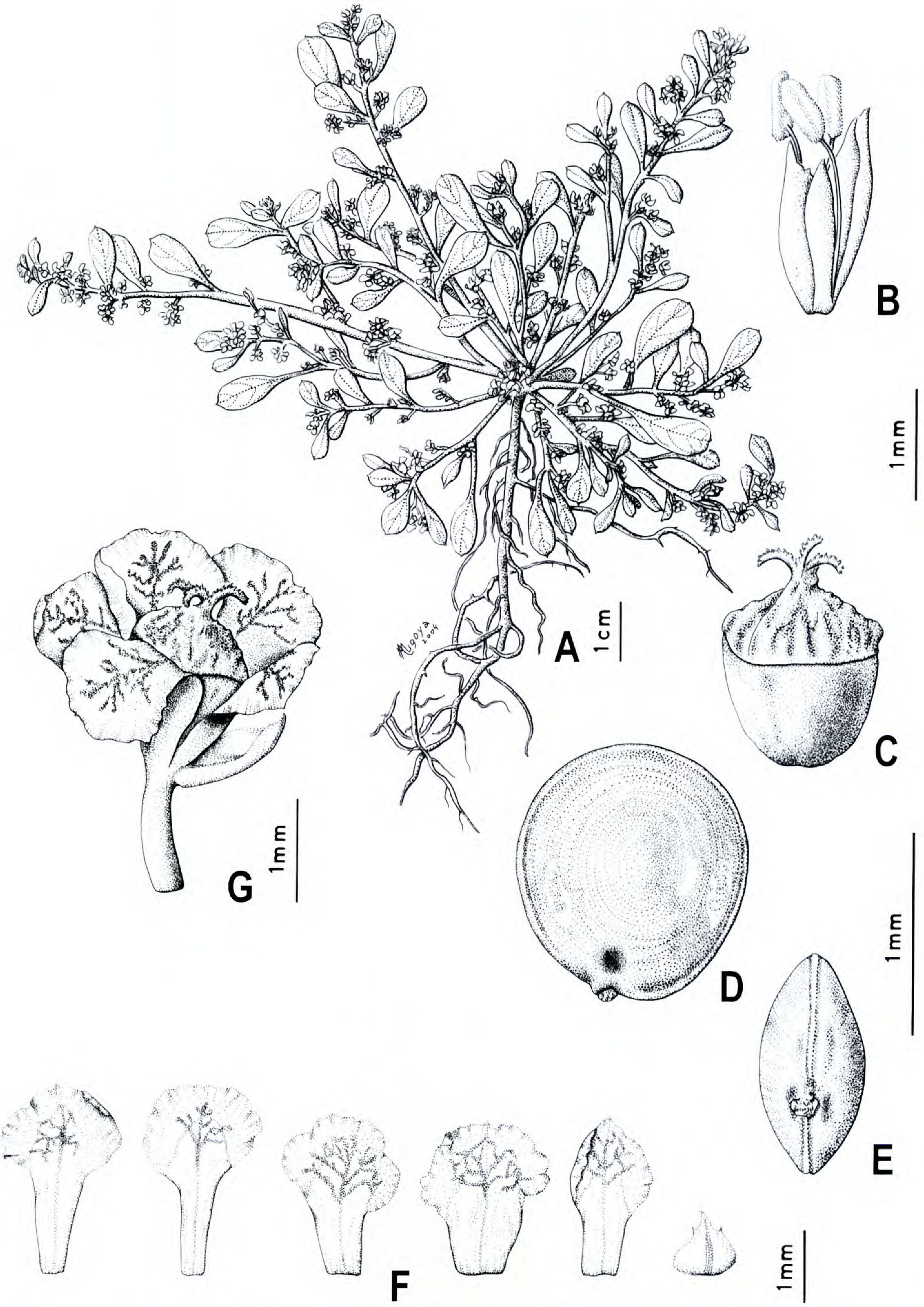

Figure 1. *Amaranthus hunzikeri* N. Bayón. —A. Habit. —B. Staminate flower. —C. Ovary. —D. Seed, lateral view. —E. Seed, hilar view. —F. Sepals of pistillate flower and bracteole. —G. Pistillate flower. Drawn from the holotype, *Reca & Ramadori 17* (SI).

× 0.50–0.55 mm, smooth surface and glossy centrally on the convex faces, otherwise minutely granular and dull, margin slightly notched at the seed scar.

Etymology. The specific epithet honors Armando Teodoro Hunziker (1919–2001), an Argentinian botanist who studied the genus *Amaranthus* extensively.

Distribution, habitat, and phenology. *Amaranthus hunzikeri* is known only from the Andes in the northwestern Argentinian provinces of Catamarca and Jujuy, where it is found at altitudes between 3200 and 3500 m, between the Tropic of Capricorn and S26°50′ within the Puneña phytogeographic province. As the label of the holotype indicates, it prefers damp sites known as "vegas." Both the holotype and paratype were collected in March with flowers and fruits.

IUCN Red List category. This species is known only from the two type specimens, so there is not enough information about its distribution or population status. Therefore, it is not possible to assess its risk of extinction, and it must be included in the category DD (Data Deficient) according to IUCN Red List criteria (IUCN, 2001).

Relationships. *Amaranthus hunzikeri* is similar to other South American species having urceolate flowers with the upper portion of the spatulate sepals partially bent outward. *Amaranthus hunzikeri* resembles *A. cardenasianus* Hunziker, with the latter differing in being an erect herb ca. 70 cm in height with ovate-rhombic leaf blades (4.5–6.5 × 2.4–3.4 cm) that are acuminate or more or less acute apically. The inflorescence of *A. cardenasianus* is mainly terminal and erect (12 × 3 cm), with the staminate flowers bearing five sepals and five stamens. The sepals of the pistillate flowers of *A. cardenasianus* have a green midvein with only two or three short secondary veins. *Amaranthus urceolatus* Bentham differs from *A. hunzikeri* by having erect stems, oblong or ovate-elliptic leaves, and narrower flowers with the fully expanded perianth being ca. 2 mm in diameter distally and with two or three stamens and five sepals in the staminate flower. The sepals of *A. urceolatus* are joined basally, and the fruits are typically indehiscent. The main differences between *A. hunzikeri* and *A. squamulatus* (Andersson) B. L. Robinson are that the latter has erect stems, nonspatulate leaf blades, three stamens and five sepals in the staminate flower, and generally indehiscent fruits.

Key to the Species of *Amaranthus* sect. *Pyxidium* with Four or Five Sepals in the Pistillate Flowers

1a. Sepals of pistillate flowers not spatulate.
  2a. Inflorescence of solitary or aggregated terminal spikes.
    3a. Inflorescence of solitary spikes or aggregated into a panicle; sepals of pistillate flowers broadly ovate, base contracted into claw, with mucro 0.3–0.5 mm . . . . . *A. pallidiflorus* F. Mueller
    3b. Inflorescence of interrupted terminal long spikes; sepals of pistillate flowers oblong or obovate, base not contracted into claw, with mucro 0.1–0.2 mm . . . . . *A. leptostachyus* Bentham
  2b. Inflorescence of axillary clusters, which are often confluent above in a leafy pseudo-spike.
    4a. Pistillate flowers with 5 obtuse or emarginated sepals. . . . . *A. clementii* Domin
    4b. Pistillate flowers with 4 or 5 acute sepals.
      5a. Leaves (at least in larger stems) 10 mm or more wide; sepals of pistillate flowers narrowly oblong, ovate or obovate, unequal, with mucro 0.2 mm . . *A. blitoides* S. Watson
      5b. Leaves less than 10 mm in width; sepals of pistillate flowers lanceolate to oblong-lanceolate, subequal, with acuminate tip 0.25–1 mm. . . . . *A. praetermissus* Brenan
1b. Sepals of pistillate flowers spatulate.
  6a. Peduncles and bracts enlarged and hardened; sepals narrowly spatulate, without many veins; stigmas wide at base . . . . . *A. scleropoides* Uline & W. L. Bray
  6b. Peduncles and bracts neither enlarged nor hardened; sepals broadly spatulate, with branched midvein; stigmas narrow at base . . . . . *A. hunzikeri* N. Bayón

Paratype. ARGENTINA. **Jujuy:** Susques, 5 Mar. 1927, *A. Castellanos s.n.* (BA 27795).

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New Species of *Stenospermation* and *Xanthosoma* (Araceae) from Bajo Calima, Valle Department, Colombia

Thomas B. Croat
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
thomas.croat@mobot.org

Dorothy C. Bay
Department of Biology, Missouri Southern State College, 3950 E. Newman Rd., Reynolds Hall 307, Joplin, Missouri 64801-1595, U.S.A. Bay-D@mssu.edu

Emily D. Yates
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A. Current address: Chicago Botanic Garden, 1000 Lake Cook Road, Glencoe, Illinois 60022, U.S.A.
eyates@chicagobotanic.org

Abstract. Eight new species of *Stenospermation* Schott and *Xanthosoma* Schott (Araceae) from Bajo Calima, Colombia, are described as new: *Stenospermation ellipticum* Croat & D. C. Bay, *S. escobariae* Croat & D. C. Bay, *S. flavum* Croat & D. C. Bay, *S. glaucophyllum* Croat & D. C. Bay, *S. monsalvae* Croat & D. C. Bay, *S. velutinum* Croat & D. C. Bay, *Xanthosoma guttatum* Croat & D. C. Bay, and *X. hebetatum* Croat & D. C. Bay.

Resumen. Ocho nuevas especies de *Stenospermation* Schott y *Xanthosoma* Schott (Araceae) de Bajo Calima, Colombia se describe como nueva: *Stenospermation ellipticum* Croat & D. C. Bay, *S. escobariae* Croat & D. C. Bay, *S. flavum* Croat & D. C. Bay, *S. glaucophyllum* Croat & D. C. Bay, *S. monsalvae* Croat & D. C. Bay, *S. velutinum* Croat & D. C. Bay, *Xanthosoma guttatum* Croat & D. C. Bay y *X. hebetatum* Croat & D. C. Bay.

Key words: Araceae, Colombia, IUCN Red List, *Stenospermation*, *Xanthosoma*.

This manuscript treats six new species of *Stenospermation* Schott (Araceae) and two new species of *Xanthosoma* Schott (Araceae) from Bajo Calima, Valle Department, Colombia. The aim of this manuscript is to publish these new species in preparation for a more thorough treatment in an entire Flora of the Bajo Calima Region. The Bajo Calima region, covering roughly 80,000 ha. of lowland tropical rainforest, is located on the Pacific Andean slopes in central Colombia and is known to be one of the centers of diversity for Araceae (Bay, 1996).

The genus *Stenospermation*, with 43 known species (including those proposed here), ranges from Guatemala to the Guianas, Brazil, and Bolivia. It is primarily Andean in distribution with most species occurring in Colombia and Ecuador. The genus is disjunct with many fewer species in eastern South America. Most species occur at middle elevations, and thus it is interesting to see so many species (a total of 14 in the Bajo Calima region) found in the area of Bajo Calima, which is near sea level. *Stenospermation* is clearly the most poorly known genus in the family, with probably as many as four fifths of the total species remaining undescribed.

Xanthosoma is more widespread than *Stenospermation*, ranging from Mexico and the West Indies to Argentina and occurring over a wide elevational and ecological range. The genus has 60 published species with an additional eight to 10 more known unpublished species in Ecuador alone. Still, while there are undoubtedly other new species to be described, it is unlikely that the genus will end up with more than 100 species.

1. Stenospermation ellipticum Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., on Carretera Hanz, less than 100 m, 1 Mar. 1990, *T. B. Croat 71062* (holotype, MO-3780456; isotypes, CUVC, US).

Planta epiphytica, raro terrestris; internodia 5–15 mm longa, 1.5–3 cm diam., plerumque basibus petiolorum obtecta; cataphylla decidua; petiolus 16.5–49 cm longus, teres, anguste sulcatus, prope basim striatus, vaginatus usque ad medium, vagina atrovirenti maculata; lamina elliptica, late rotundata, apice abrupte acuminata, 23.5–35 cm longa,

8.3–17 cm lata, nitida; inflorescentia 1; pedunculus 21–34 cm longus, in sicco 2–3 mm diam., cernuus; spatha viridis; spadix sessilis, 5.5–6.5 cm longus, flavus; stigma rotundum, 0.3–0.5 mm diam.

Epiphytic, rarely terrestrial; stem appressed-climbing; *internodes* short, often obscured by petiole bases, 5–15 mm × 1.5–3 cm, as long as broad; roots few per node; *cataphylls* deciduous. LEAVES erect to erect-spreading; *petioles* 16.5–49 cm, yellow-green, semiglossy, longitudinally striate near base, terete to subterete above sheath, weakly to narrowly sulcate above sheath, petiole and sheath drying dark olive-brown; sheath 10.5–23 cm, 0.3–0.6(0.8) times as long as petiole, densely dark green-speckled; margin of sheath drying papery and pale, one margin acute and one margin rounded at apex; *blades* elliptic, coriaceous, rarely subcoriaceous, broadly rounded and abruptly acuminate at apex, obtuse at base, 23.5–35 × 8.3–17 cm, 1.7–3.1 times longer than wide, 0.6–1.6(1.9) times longer than petiole, broadest at middle, upper surface glossy to semiglossy, dark green to yellow-green, drying conspicuously glossy, dark olive-green, many minute white raphides easily visible with a 10× lens, lower surface semiglossy to matte, paler to much paler than above, drying glossy and slightly paler than above; *midrib* narrowly sunken and marginally discolorous above, convex and paler below; *primary lateral veins* departing midrib at 30°–50° angles, weakly visible to obscure above, obscure below, drying raised above, barely raised below. INFLORESCENCES 1 per axil, erect; *peduncle* 21–34 cm × 2–3 mm (dry), cernuous; *spathe* green, promptly deciduous; *spadix* sessile, cylindrical, 5.5–6.5 cm × 6–7 mm (dry), yellow. Flowers hexagonal to irregularly square; stigma round, 0.3–0.5 mm diam.; stamens with filaments to 1 mm long; thecae oblong. INFRUCTESCENCE unknown.

Distribution and habitat. The species is known to occur in Colombia on the western slopes of the Cordillera Occidental in the Departments of Chocó and Valle and the eastern slopes of the Cordillera Central in the Department of Antioquia. It occurs in Premontane wet forest transition to Tropical (P-wf/T) and Tropical rainforest transition to Premontane (T-rf/P) life zones (Holdridge et al., 1971), from 30 to 1440 m elevations. This new species has been collected from primary forest, disturbed forest, and along forested stream banks.

Phenology. *Stenospermation ellipticum* has been collected in flower from March to August in the Bajo Calima region.

Stenospermation ellipticum is distinguished by its usually epiphytic habit; short internodes; conspicuously glossy elliptic blades (hence the epithet) with a broadly rounded base, abruptly acuminate apex, and dark green-speckled petioles, usually sheathed about halfway; and sessile yellow spadices on long peduncles to 34 cm.

Stenospermation ellipticum may be confused with *S. maximum* Engler, because they are both large-bladed species with prominent venation on the upper blade surface. The latter species differs in having blades with a tapering acuminate apex, drying dull olive-green, and a stipitate spadix with a spathe that persists well into anthesis.

Another species that might be confused with *Stenospermation ellipticum* from Colombia is *S. arborescens* Madison, a plant collected from high Ecuadorian cloud forests. The latter species differs by occurring as a terrestrial arborescent plant, to 3 m tall, with large (50–60 cm long) blades and white spadices that are stipitate to 1–1.5 cm.

Another species similar to Colombian *Stenospermation ellipticum* is *S. crassifolium* Engler, which occurs as an epiphyte in the Peruvian Amazon basin. *Stenospermation crassifolium* differs from *S. ellipticum* in having blades that are larger (45 cm vs. 8.3–17 cm) and more acute at the apex, and a spadix that is stipitate to 1 cm.

IUCN Red List category. Conservation status for *Stenospermation ellipticum* must be considered as LC (Least Concern) according to IUCN Red List criteria (IUCN, 2001), because it is known from many collections and has been found in Antioquia, Chocó, and Valle Departments.

Paratypes. COLOMBIA. **Antioquia:** El Castrillón, San Luis, *Loaiza et al. 153* (HUA), *169* (HUA); San Luis, Medellín–Bogotá rd., Río Tebaida, Km 100–125, *Callejas et al. 3421* (MO); San Luis, San Luis–San Carlos rd., Km 12, *Callejas et al. 4310* (MO). **Chocó:** Bolívar–Quibdó, Km 134.5, *Croat 55909* (B, K, MO, NY); San José del Palmar–Novita rd., ca. 3 km W of San José del Palmar, *Croat 56648* (COL, MO). **Valle:** Buenaventura–Málaga rd., Km 33.3, *Croat 61359* (CUVC, MO), Km 44, *Croat & Watt 70203* (MO), Km 50.5, *Croat & Bay 75604* (CUVC, MO), Km 52.4, *Croat & Bay 75725* (CUVC, K, MO); 1 km W of Carretera Gasolina, 6 km S of Buenaventura–Málaga rd. on Carretera Gasolina, *Croat 69402* (CUVC, MO); Carretera Hanz, *Croat 71062* (MO); Quebrada de La Brea, *Schultes & Villarreal 7380* (US); old Cali–Buenaventura rd., 29 km beyond jct. with new hwy., *Croat 38597* (MO); Bahia Málaga, vic. Base Naval Málaga, along rd. to Buenaventura, ca. 1 km from base, ca. Km 104, *Croat & Gaskin 80474* (CUVC, MO).

2. **Stenospermation escobariae** Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 51.3, deep gorge, ca. 4°09′N, 77°11′W, less than 100 m, 27 Feb. 1990, *T. B. Croat 71000* (holotype, MO-3784468).

Planta terrestris, interdum hemiepiphytica; internodia suberosa, 1–3 cm longa, 5–15 mm diam., pallide rubrobrunnea; cataphylla 13.5–18 cm longa, decidua; petiolus 13.5–23 cm longus, rigidus, vaginatus usque ad medium, marginibus vaginae scariosis; lamina elliptica usque oblanceolata, longe acuminata apiculataque, 16–28(35.5) cm longa, 3–7.5(9.5) cm lata; inflorescentia 1; pedunculus 7–22 cm longus, cernuus; spatha 14–22 cm longa, alboviridis vel alba; spadix usque 8 mm stipitatus, flavovirens vel flavus; stigma oblongum vel lineare, 0.8–1 mm longum; infructescentia veneta.

Usually terrestrial, sometimes hemiepiphytic; stem erect or appressed-climbing; *internodes* conspicuously transversely fissured, corky, gray, sometimes pale reddish brown, 1–3 × 0.5–1.50 cm, slightly longer than broad, drying gray, corky; roots 1 to 2 or none per node at upper nodes, drying gray; *cataphylls* 13.5–18 cm, long-tapered at apex, promptly deciduous. LEAVES erect; *petioles* stiff, 13.5–23 cm, dark green; sheath 9–17.5 cm, 0.4–0.8 times as long as petiole, dark green with pale brown scarious margins, gradually tapered at apex, drying dark brown with longitudinal wrinkles and pale scarious margins; *blades* elliptic to oblanceolate, subcoriaceous, long-acuminate at apex (acumen downturned and apiculate), attenuate to cuneate at base, 16–28(35.5) × 3–7.5(9.5) cm, (3.3)3.8–5.3 times longer than wide, 0.9–1.8 times longer than petiole, broadest at middle or more often beyond middle, upper surface glossy to semiglossy, dark green, drying dull, dark olive-brown, lower surface semiglossy, paler, drying glossy, medium brown; *midrib* narrowly sunken, concolorous above, narrow-raised and paler than blade below, drying concolorous with blade on both sides or sometimes paler below; *primary lateral veins* moderately obscure, but slightly puckering the blade, drying obscure or slightly raised below, departing midrib at 40°–50° angles; minor veins obscure. INFLORESCENCE 1 per axil, arching; *peduncle* 7–22 cm, cernuous, not fully erect at anthesis, equal to or longer than petiole; *spathe* 14–22 cm, long-tapered, light green becoming white, promptly deciduous at anthesis; *spadix* stipitate to 8 mm, cylindrical, 10+ cm long (all specimens broken off at some point along their length), 6–8 mm diam. (dry), yellowish green, becoming yellow at anthesis. Flowers hexagonal, stylar surface papillose; stigma oblong or linear, drying 0.8–1 mm, brown; stamens with filaments 1.2–1.4 mm; thecae oblong. INFRUCTESCENCE to 15 cm long, drying 1 cm wide; *berries* bluish green, matte; seeds 1.5–2 mm.

Distribution and habitat. The species ranges along the Pacific Andean slopes of Colombia in the Departments of Antioquia, Chocó, Nariño, and Valle to the Carchi Province of Ecuador in Tropical rainforest (T-rf) and Tropical rainforest transition to Premontane (T-rf/P), from near sea level to 1850 m. It has been collected from primary rainforest, regrowth forest, and forested stream banks.

Phenology. *Stenospermation escobariae* has been collected in flower in April, November, and December, and in fruit in February and March.

Stenospermation escobariae is easily recognized by the gray, corky stem and the stiff, dark green petioles sheathed halfway or more but not entirely, with the sheath having pale, scarious, gradually tapered margins. In addition, the blades appear to be puckered by the moderately obscure primary lateral veins. Also distinctive is the matte and bluish green infructescence.

One paratype collection (*Croat 56092*) differs slightly in having blades that are matte on the upper surface. Two other paratype collections (*Callejas 7179* and *Franco et al. 5017*) differ in having stems only slightly scurfy rather than corky.

Etymology. The species is named in honor of the late Linda Katherine Albert de Escobar (1940–1993), an American botanist, who made one of the first collections of the species from the Bajo Calima region.

IUCN Red List category. Conservation status for *Stenospermation escobariae* must be considered as LC (Least Concern) according to IUCN criteria (IUCN, 2001), because it is known from many collections and has been found in four Departments in Colombia and in Ecuador.

Paratypes. COLOMBIA. **Antioquia:** Guatapé, Santa Rita rd., Vía Guatapé–La Almanera, *Callejas 7179* (MO). **Chocó:** Serranía de Baudó, Las Animas–Pato rd., on Río Pato, about 5 km SW of Pato, *Croat 56092* (COL, HUA, MO). **Nariño:** Barbacoas, Altaquer, Res. Nat. Río Ñambí, *Franco et al. 5017* (MO). **Valle:** Buenaventura–Málaga rd., Km 12.5, *Croat 70151* (MO), Km 35.2, *Croat & Bay 75757* (CUVC, MO); village of Bajo Calima, *de Escobar et al. 4007* (HUA); Pacific Coast, Río Cajambre, *Cuatrecasas 17227* (US). ECUADOR. **Carchi:** Maldonado, Tobar Donoso, Awá Ethnic Res., *Aulestia et al. 655* (MO).

3. **Stenospermation flavum** Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 50.7, 50–100 m, 12 July 1993, *T. B. Croat & D. C. Bay 75691* (holotype, MO-04575801).

Planta epiphytica; internodia 1–3 cm longa, 1.5–1.7 cm diam., rubrobrunnea usque purpurea, basibus petiolorum obtecta; cataphylla decidua; petiolus 16–31 cm longus, teres, anguste sulcatus, 1/2 usque 2/3 partem longitudinis vaginatus, vagina introrsum crispa; lamina longe elliptica, 31–35 cm longa, 5.5–6.8 cm lata; inflorescentia 1; pedunculus 30–31.5 cm longus, cernuus; spatha cremeoflava; spadix usque 6 mm stipitatus, 9.5–12 cm longus, cremeoflavus; stigma oblongum, 0.3–0.5(0.7) mm longum.

Epiphytic; stem appressed-climbing; *internodes* short, 1–3 × 1.5–1.7 cm, reddish brown to purple, obscured by petiole bases, drying dark brown; *cataphylls* promptly deciduous. LEAVES spreading; *petioles* 16–31 cm, terete, narrowly sulcate; sheath incurled, 12–16.5 cm, 0.5–0.7 times as long as petiole, ± equal at apex; *blades* oblong-elliptic, subcoriaceous, acuminate at apex (acumen down-turned), attenuate to cuneate to slightly rounded at base, 31–35 × 5.5–6.8 cm, 4.8–5.8 times longer than wide, 1–1.8 times longer than petiole, broadest at middle, upper surface semiglossy, dark green, drying dull, olive-green to olive-brown, lower surface glossy, moderately paler or yellowish green, drying semi-glossy and paler than above; *midrib* narrowly sunken above, convex and paler below; *primary lateral veins* numerous, departing midrib at 20°–25° angles, obscure both sides, drying raised above, barely raised below. INFLORESCENCE 1 per axil, erect; *peduncle* drying 30–31.5 cm × 2–3 mm, cernuous, medium green, apex of peduncle darker and somewhat swollen, about 1–2 cm, drying dark olive-green, becoming stramineous in age; *spathe* coriaceous, to 18.5 cm, glossy, creamy yellow, long-tapered; *spadix* stipitate to 6 mm, cylindrical, 9.5–12 cm × 6–9 mm (dry), creamy yellow. Flowers hexagonal; stigma oblong, 0.3–0.5(0.7) mm; stamens on filaments 1.7–2 mm; thecae oblong. INFRUCTESCENCE unknown.

Distribution and habitat. The species is known only from the Pacific Andean slopes of Colombia, in the Bajo Calima region, an area of Tropical rainforest transition to Premontane (T-rf/P), from 50 to 150 m. It has been collected in areas of older regrowth forest.

Phenology. *Stenospermation flavum* has been collected in flower only in July in the Bajo Calima region.

Stenospermation flavum is characterized by the oblong-elliptic blades with lower surfaces that are often yellowish green, drying olive-green to olive-brown, and petioles that are sheathed halfway or more with the sheath incurled. In addition, the long-tapered inflorescences remain cernuous, and both spathes and spadices are a distinctive creamy yellow. The specific epithet is derived from the color of the lower blade surface and the spadix ("flavus" meaning yellow).

Stenospermation flavum might be confused with *S. monsalvae* Croat & D. C. Bay; however, the latter species differs in drying a much darker and redder brown and having blades that are shorter (mostly 12.5–23.5(28.3) cm for *S. monsalvae* vs. 31–35 cm for *S. flavum*), with petiole sheaths that have scarious margins unequal at the apex. In addition, *S. monsalvae* has a shorter spathe (less than 14 cm vs. to 18.5 cm for *S. flavum*) that is more blunt at the apex and is green (as opposed to yellow in *S. flavum*).

Another species with which *Stenospermation flavum* might be confused is *S. robustum* Engler. However, the latter species differs in having a blade that is broader with a lower length:width ratio (4.8–10.5 cm wide and 2.9–4.3 times longer than wide for *S. robustum* vs. 5.5–6.8 cm wide and 4.8–5.8 times longer than wide for *S. flavum*), more rounded at base, and usually drying reddish brown. It also differs in having a spathe and spadix that are both white.

IUCN Red List category. Conservation status for *Stenospermation flavum* must be considered as DD (Data Deficient) according to IUCN criteria (IUCN, 2001), because the species is known from only two collections.

Paratypes. COLOMBIA. **Valle:** Buenaventura–Málaga rd., Km 50.5, *Croat & Watt 70340* (MO).

4. Stenospermation glaucophyllum Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 12.5, 100–150 m, 4 Feb. 1990, *T. B. Croat 70147* (holotype, MO-3786855; isotypes, CUVC, US).

Planta plerumque terrestris, interdum hemiepiphytica; internodia 1–3 cm longa, 1–1.3 cm diam.; cataphylla decidua; petiolus 6.3–23 cm longus, 3/5 usque 9/10 partem longitudinis vaginatus; lamina ovata ellipticave, 10–29 cm longa, 4.1–11 cm lata, infra albida, glauca; inflorescentia 1; pedunculus 21–31 cm longus, cernuus; spatha usque 12.5 cm longa, alba; spadix stipiti 6–11 mm longo insidens, 7.5–8.5 cm longus, flavus; stigma ovatum vel lineare, 0.5–1.5 mm latum; infructescentia usque 17.5 cm longa; baccae virides.

Usually terrestrial, sometimes hemiepiphytic; stem upright or appressed-climbing; *internodes* short, 1–3 × 1–1.3 cm, longer than broad, semiglossy, medium green to olive-green, drying light brown, longitudinally wrinkled; roots mostly at base of plant or 1 to 2 per node; *cataphylls* to 9 cm, rounded at apex, light green, deciduous. LEAVES spreading; *petioles* 6.3–23 cm, sheath 5.8–14 cm, 0.6–0.9 times as long as petiole, light green with wide (to 4 mm) scarious margin, one side acute and the other rounded at apex; geniculum sulcate; *blades* ovate to elliptic, subcoriaceous, short-acuminate at apex (acumen down-turned), obtuse at base, 10–29 × 4.1–11 cm, 2.5–3.2 times longer than wide, 1.3–2 times longer than petiole, broadest at middle, upper surface semiglossy, dark green, drying semiglossy, olive-green, lower surface matte, glaucous, white to pale green, drying dull, pale willow-green; *midrib* narrowly sunken, marginally discolorous above, convex, paler than above, sometimes yellow below, drying concolorous above and below; *primary lateral veins* obscure, departing midrib at 40°–50° angles, drying slightly raised above and below. INFLORESCENCES erect;

peduncle 21–31 cm × 3–5 mm (dry), longer than petiole, cernuous, remaining so at anthesis, medium green, drying olive-green; *spathe* to 12.5 cm, white, long-tapered; *spadix* stipitate 6–11 mm, cylindrical, 7.5–8.5 cm × 7–9 mm (dry), yellow. Flowers hexagonal; stylar surface papillose; stigma ovate-elliptic to linear, 0.5–1.5 mm diam. (dry), light brown; stamens with filaments to 3 mm; thecae oblong. INFRUCTESCENCE to 17.5 cm; *berries* ovoid, medium green; seeds cylindrical, pearly white.

Distribution and habitat. The species is known only from the Bajo Calima region of Colombia, an area of Tropical rainforest transition to Premontane (T-rf/P), from 50–150 m. It has been collected in areas of regrowth forest.

Phenology. *Stenospermation glaucophyllum* has been collected in flower in February and July, and in fruit in February.

Stenospermation glaucophyllum is characterized by the blades, which are matte, white to pale green, and glaucous below (hence the name "glaucus," meaning glaucous and "phyllum," meaning leaf); petioles sheathed more than midway with the sheath having a wide scarious margin; short (less than 3 cm) internodes; and the inflorescence that remains cernuous. This species is often afflicted with a pathogen that causes minute, pale yellow spots on every part of the plant except the stem. A similar pathogen is found on *Anthurium fragrans* Croat & D. C. Bay, a species that also exhibits pale yellow spots.

This species might be confused with *Stenospermation ellipticum* because they have similarly shaped blades that are dark green above, also paler and matte below. However, *S. ellipticum* differs in having larger blades (23.5–43 cm long) that are merely pale below not glaucous, drying dark reddish brown, petioles that are speckled, and a sessile spadix.

IUCN Red List category. Conservation status for *Stenospermation glaucophyllum* must be considered as NT (Near Threatened) according to IUCN criteria (IUCN, 2001). Although locally common in the area of the type locality, it is not yet known from other sites in Colombia. It is possible that the species is more widespread than is currently known because much of the Pacific slope is still poorly known.

Paratypes. COLOMBIA. **Valle:** Buenaventura–Málaga rd., Km 11, *Kennedy & Andrews 1321* (SEL), *Croat 62783* (CUVC, MO), *69306* (CUVC, MO, VALLE); Bahia Málaga near Base Naval Málaga, along rd. to Buenaventura, ca. 1 km from base, ca. Km 104, *Croat & Gaskin 80475* (CUVC, MO); vic. of Bahia Málaga, near Base Naval Málaga, along trail along the edge of the bay W of base headquarters, *Croat & Gaskin 80596* (CUVC, MO).

5. Stenospermation monsalvae Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 50.7, less than 100 m, 12 July 1993, *T. B. Croat & D. C. Bay 75690* (holotype, MO-04575803; isotypes, COL, CUVC, K, US).

Planta plerumque epiphytica, interdum terrestris; internodia 1–2 cm longa, 7–17 mm diam.; cataphylla decidua; petiolus (5.8)8–15.5 cm longus, teres, acute vel anguste sulcatus, usque ad 0.4–0.7(0.9) partem longitudinis vaginatus; lamina lanceolata vel elliptica, (9)12.5–23.5(28.3) cm longa, 3–5(7) cm lata; inflorescentia 1; pedunculus 20–36.5 cm longus, cernuus; spatha 6.3–13.8 cm longa, viridis; spadix usque 5–12 mm stipitatus, 3.7–9.5(13.5) cm longus, albus, sub anthesi flavescens; stigma ovatum, 0.5–0.7 mm longum; infructescentia 5–9 cm longa; baccae aurantiacae.

Usually epiphytic, occasionally terrestrial; stem appressed-climbing, or scandent; *internodes* short, 1–2 cm × 7–17 mm, semiglossy, yellow-green becoming brown, drying dark brown; *cataphylls* 3.5–11.5 cm, apiculate at apex, drying dark brown, deciduous. LEAVES erect to spreading; *petioles* (5.8)8–15.5 cm × 1–3 mm (dry), terete, sharply to narrowly sulcate; sheath 4–10.8 cm, 0.4–0.7(0.9) times as long as petiole, one side acute and the other rounded at apex, medium green with scarious margin, drying dark brown with pale margin; *blades* lanceolate to elliptic, subcoriaceous, abruptly acuminate at apex (acumen downturned), usually attenuate, sometimes cuneate, or rarely rounded at base, (9)12.5–23.5(28.3) × 3–5(7) cm, 3.2–5.9(6.7) times longer than wide, 1.2–1.8(2.3) times longer than petiole, broadest near middle, upper surface semiglossy to glossy, dark green, weakly bicolorous, drying dull, reddish brown to olive-brown, lower surface drying semiglossy and paler than above; *midrib* narrowly sunken, sometimes weakly discolored along margin above, convex and paler below, drying slightly darker than surface below; *primary lateral veins* numerous, obscure, departing midrib at 25°–30° angles, drying barely raised below or obscure on both sides. INFLORESCENCE 1 per axil, spreading to pendulous; *peduncle* 20–36.5 cm × 1–3 mm (dry), cernuous, drying medium to dark or reddish brown; *spathe* 6.3–13.8 cm, green, abruptly acuminate to long-tapered; *spadix* stipitate 5–12 mm, cylindrical, 3.7–9.5(13.5) cm × 6–8 mm, white becoming yellow at anthesis. Flowers hexagonal, surface of ovary with numerous short white raphides; stigma ovate, 0.5–0.7 mm diam.; stamens with filaments to 1.8 mm; thecae oblong. INFRUCTESCENCE 5–9 × 1–1.5 cm (dry); *berries* orange, surface of ovary drying pale white with numerous dark red punctations (under 10× magnification); seeds oblong to clavate, 2.1–2.3 mm.

Distribution and habitat. The species is known only from the Pacific Andean slopes of Colombia, in

the Departments of Chocó and Valle, in areas of Tropical rainforest (T-rf) and Tropical rainforest transition to Premontane (T-rf/P), from sea level to 465 m. It has been collected in areas of regrowth forest and primary forest.

Phenology. *Stenospermation monsalvae* has been collected in flower in January, February, May, July, August, November, and December and in fruit in May, August, September, and November in the Bajo Calima region.

Stenospermation monsalvae is characterized by the petioles, which are narrowly sulcate, sheathed one third to three fourths of the way, and blades that usually dry reddish brown, sometimes olive-brown, with obscure veins. Also distinctive are the pendent inflorescences on thin peduncles with green spathes, and long-stipitate yellow spadices that are orange in fruit.

Etymology. The species is named in honor of Miryam Monsalve (1955–), a Colombian botanist from Cali and a specialist on the Bajo Calima flora, who has made many collections of this species. Miryam was one of the first botanists to work in the Bajo Calima region after it was opened up for exploration by Cartón de Colombia.

IUCN Red List category. Conservation status for *Stenospermation monsalvae* must be considered as LC (Least Concern) according to IUCN criteria (IUCN, 2001), because it is known from many collections and has been found in both Chocó and Valle Departments.

Paratypes. COLOMBIA. **Chocó:** Corcovada region, upper Río San Juan, ridge along Yeracüí valley, *Killip 35261* (US); Bagado–Cértegui trail, *Juncosa 1520* (MO); Quibdó–Bolívar, Km 175–176, 117–118 km E of Quibdó, *Croat 57506* (MO). **Valle:** Buenaventura–Málaga, Km 11, *Gentry 35256* (MO), *62815* (CUVC), *Juncosa 2140* (CUVC), *Monsalve 189* (MO), *300* (MO), *548* (MO), *850* (MO), *894* (MO), *907* (MO), *2070* (CUVC), *Stein et al. 3245* (MO), *van der Werff & Monsalve 9693* (CUVC, MO); Km 22, Carr. Hanz, *Croat 69472* (CUVC, MO); Km 28, Carr. Nac., *Monsalve 3061* (CUVC, MO); Carr. Dindo, *Monsalve 1137* (MO), *1144* (MO); Km 33.3, *Croat 61290* (COL, MO); Km 39, San Isidro, *Devia 2793* (TULV), *Daly et al. 6039* (CUVC, NY); Km 42–43, *Croat & Watt 70308* (MO); Km 44, *Croat & Watt 70181* (MO); Km 50.5, *Croat & Watt 70339* (MO); Km 65–66, *Croat 71051A* (MO); rd. to Juanchaco Palmeras, *Gentry et al. 47836* (MO); Bahia Málaga, vic. Base Naval Málaga, along rd. to Buenaventura, ca. 1 km from base, ca. Km 104, *Croat & Gaskin 80471* (CUVC, MO); vic. of Bahia Málaga, Base Naval Málaga, Río Bongito, *Croat & Gaskin 80544* (CUVC, MO).

6. Stenospermation velutinum Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 44, less than 100 m, 5 Feb. 1990, *T. B. Croat & J. Watt 70232* (holotype, MO-3784020; isotypes, QCNE, VEN).

Planta epiphytica, raro terrestris; internodia 1–4 cm longa, 5–17 mm diam.; cataphylla decidua; petiolus 8–17 cm longus, circa 7/10 partem longitudinis vaginatus; lamina ovata usque anguste elliptica, 14–33 cm longa, 3.5–7.8 cm lata, supra velutina, infra hebatata; inflorescentia 1; pedunculus 6–11 cm longus, primo cernuus, juxta anthesim erectus; spatha 6–7 cm longa, viridis vel alba vel flavoviridis; spadix usque 6 mm stipitatus, 4–6 cm longus, flavalbus vel flavoviridis; stigma oblongum vel lineare, 1.2–1.3 mm longum.

Epiphytic, rarely terrestrial; stem appressed-climbing or scandent; *internodes* semiglossy, 1–4 cm × 5–17 mm, longer than broad, gray-green to dark green becoming light brown, drying gray; roots few per node; *cataphylls* deciduous. LEAVES erect; *petioles* 8–17 cm, oval in cross section; sheath 8–11.6 cm, 0.7 as long as or equal to petiole, tapered at apex, sometimes one side obtuse at apex; *blades* ovate to narrow-elliptic, subcoriaceous, acuminate at apex, attenuate at base, 14–33 × 3.5–7.8 cm, 3.8–4.5 times longer than wide, 1.9–2.8 times longer than petiole, broadest at middle or slightly beyond middle, upper surface velvety, dark green, drying dull, dark olive-green, lower surface matte, paler than above, drying dull, slightly paler than above; *midrib* narrowly sunken and marginally discolorous above, paler and obtusely raised below; *primary lateral veins* obscure, departing midrib at 20°–30° angles; minor veins obscure. INFLORESCENCE 1 per axil, erect; *peduncle* 6–11 cm × 2–3 mm (dry), cernuous becoming erect near anthesis; *spathe* 6–7 cm, green becoming white to yellowish green, long-tapered at apex, drying black; *spadix* stipitate to 6 mm, cylindrical, bluntly tapered at apex, 4–6 cm × 8–10 mm (dry), yellowish white to yellowish green. Flowers hexagonal; stigma oblong to linear, 1.2–1.3 mm diam. (dry); stamens with filaments 2.4–2.6 mm; thecae ovate to oblong. INFRUCTESCENCES unknown.

Distribution and habitat. The species is known only from the Bajo Calima region in Tropical rainforest transition to Premontane (T-rf/P), from 50–150 m. It has been collected in areas of older regrowth forest.

Phenology. *Stenospermation velutinum* has been collected in flower in February, March, and September.

Stenospermation velutinum is characterized by blades that are dark green and velvety (hence the epithet from the Latin "velutinus," meaning velvety) above and matte below, petioles that are often completely sheathed, sometimes sheathed to three fourths their length, as well as by inflorescences with white spathes that dry black with yellowish spadices at anthesis.

IUCN Red List category. Conservation status for *Stenospermation velutinum* must be considered as LC

(Least Concern) according to IUCN criteria (IUCN, 2001), because it is known from many collections and has been found in both Chocó and Valle Departments.

Paratypes. COLOMBIA. **Valle:** Buenaventura–Málaga rd., Km 11, *Monsalve 409* (MO), *935A* (MO), Km 11.5, *Croat & Gaskin 79777* (CUVC, MO); 1 km W of Carr. Gasolina & 6 km S of Buenaventura–Málaga rd., *Croat 69432* (CUVC, MO); Buenaventura–Málaga rd., Km 52.4, *Croat & Bay 75720* (CUVC, MO).

7. Xanthosoma guttatum Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 51.7, 16 July 1993, *T. B. Croat & D. C. Bay 75799* (holotype, MO-04576770; isotypes, CUVC, K, US).

Planta terrestris; caulis ad apicem circa 20 cm diam.; petiolus 44–162 cm longus, teres, flavoviridis, purpureoguttatus, usque ad dimidium vaginatus marginibus vaginae purpureis et undulatis; lamina ovata, base sagittata, 40–161 cm longa, 24–100 cm lata, supra glandulosopunctata, costa et nervis lateralibus principalibus infra dense purpureoguttatis; in paginis utrisque nervis lateralibus 3–9; nervis collectivis 2–3; inflorescentiae 5; pedunculus 16–25 cm longus, purpureoguttatus; spatha 13–17 cm longa; lamina spathae extus rubroviolacea, intus albida; tubus spathae in superfaciebus ambabus atrovinaceus; spadix 12–15 cm longus, parte pistillata 1.8 cm longa, aurantiaca.

Terrestrial; trunk not visible; base of petioles at top of stem ca. 20 cm wide. LEAVES erect-spreading; *petioles* 44–162 cm, unsheathed portion terete, yellow-green, densely purple-speckled, sheathed halfway; sheath with undulate purple margins; *blades* ovate, acuminate at apex, sagittate at base, coriaceous, 40–161 × 24–100 cm, 1.4–1.6 times longer than wide, 0.9–1.4 times longer than petiole, upper surface semiglossy, dark green, drying glossy, dark brown with numerous, minute, dark, glandular punctations (at magnification of about 40×), lower surface weakly glossy, yellow-green or paler than above, drying glossy, slightly paler than above; anterior lobe 1.9–2 times longer than posterior lobes; posterior lobes acutely rounded at apex; major veins broadly rounded, pale yellow-green above, thicker than broad, paler than surface, densely purple-speckled below; *primary lateral veins* 3 to 9 per side, departing midrib at 60°–70° angles; collective veins 2 to 3, close to margin; minor veins weakly raised, darker than surface. INFLORESCENCES 5 per axil; *peduncle* erect, 16–25 cm, flesh-colored, densely violet-purple-speckled, glaucous; *spathe* 13–17 cm; spathe tube dark burgundy both surfaces, glaucous outside, glossy within; spathe blade reddish violet outside, white inside; *spadix* 12–15 cm; pistillate portion 1.8 cm × 19 mm at base (dry), 11 mm diam. at apex (dry), orange with red stigmas; staminate portion 11.8 cm; fertile staminate portion cylindrical, 10 cm × 8 mm (dry), pale pink; sterile staminate portion 1.8 cm, tan at base (lower 8 × 13 mm), white at apex (upper 1 cm × 6–7 mm). INFRUCTESCENCE unknown.

Distribution and habitat. The species is known only from the type collection made in the Bajo Calima region, on the Pacific Andean slopes of Colombia, Department of Valle, in Tropical rainforest transition to Premontane (T-rf/P), at about 30–50 m. It was collected on a narrow strip of alluvium along a stream.

Phenology. *Xanthosoma guttatum* was collected in flower in July in the Bajo Calima region.

Xanthosoma guttatum is characterized by semiglossy sagittate blades with minute dark glandular punctations on the upper surface (visible at 40× magnification) and densely purple-speckled veins on the lower surface, and densely purple-speckled petioles. Also distinctive are the glaucous inflorescences, which have spathes that are reddish violet on the outside. The specific epithet derives from the Latin "guttatum," meaning speckled.

Xanthosoma guttatum most closely resembles *X. undipes* K. Koch from Costa Rica and Panama, with which it shares convex major veins on the upper blade surface and the spathe tube dark purplish within, as well as the orange pistillate portion of the spadix. *Xanthosoma undipes* differs in being a montane species, usually occurring at above 1000 m elevation, and in lacking the dark punctations on the vegetative parts as in *X. guttatum*.

Owing to its large size, lack of a conspicuous trunk, and its large sagittate blades, *Xanthosoma guttatum* also resembles *X. robustum* Schott from Central America, but that species differs in having its major veins sunken on the upper surface, not convex as is the case with *X. guttatum*. In addition, *X. robustum* also lacks the dark punctations on its vegetative parts and has the inner surface of the spathe tube green, not dark burgundy on both inner and outer surfaces, as is the case with *X. guttatum*.

IUCN Red List category. Conservation status for *Xanthosoma guttatum* must be considered as DD (Data Deficient) according to IUCN criteria (IUCN, 2001), because it is known from only the type specimen.

8. Xanthosoma hebetatum Croat & D. C. Bay, sp. nov. TYPE: Colombia. Valle: Buenaventura–Málaga rd., Km 50.7, 12 July 1993, *T. B. Croat & D. C. Bay 75659* (holotype, MO-04572434; isotypes, COL, CUVC, K, US).

Planta terrestris; caulis usque 1 m altus; internodia 1.5–5 cm longa, usque 6 cm diam.; cataphylla decidua praeter partem basalem; petiolus 56–77 cm longus, adaxialiter

obtuse subcomplanatus, ca. 1/3 partem longitudinis vaginatus; lamina ovata, basi subhastata, 45–62.5 cm longa, 26–33.5 cm lata, supra subnitida, infra impolita, in paginis utrisque nervis lateralibus principalibus 5; infructescentia 1, erecta; pedunculus usque 8 cm longus; tubus spathae extus pallide viridis; baccae viridalbae.

Terrestrial; stem to 1 m tall, sap milky, becoming amber in age; *internodes* 1.5–5 × 6 cm, fissured both horizontally and longitudinally, dark brown, drying dark brown; *cataphylls* deciduous but persisting at bases, fibrous. LEAVES erect-spreading; *petioles* 56–77 cm, terete, obtusely flattened adaxially, somewhat spongy, medium green, faintly pale-speckled, drying dark brown, sheathed ca. 1/3 of their length; *blades* ovate, acuminate at apex, subhastate at base, thin, 45–62.5 × 26–33.5 cm, 1.7–1.9 times longer than wide, 0.8–0.9 times longer than petiole, subcoriaceous to thinly coriaceous, moderately bicolorous, upper surface semiglossy, dark green, drying semiglossy, dark olive-green, lower surface matte to weakly glossy below, paler than above, drying glossy, light olive-green; anterior lobe 1.6–1.8 times longer than posterior lobes; posterior lobes rounded to acute at apex, directed slightly outward; major veins obtusely sunken, concolorous in life and dry above, round-raised to C-shaped, paler than surface, drying slightly raised, darker than surface below; basal ribs naked to 3 cm; *primary lateral veins* usually 5 per side, departing midrib at 50°–60° angles; collective veins 2, one submarginal, one ca. 5 mm from margin; minor veins prominulous, darker than surface, the larger ones raised below. INFLORESCENCES with *peduncle* 13–14.5 cm, somewhat compressed, pale green, drying 5–7 mm wide; *spathe* 22–22.5 cm, the blade creamy white, ca. 4 cm wide at anthesis, the tube uniformly light green outside, pale greenish inside; staminate spadix and pollen cream-colored; pistillate portion yellowish, 5.8 cm, 0.7–1.3 mm diam.; staminate spadix 13.5–14 cm, the sterile portion 5 cm, ca. 1 cm diam., with thickened flowers at the base (these 3–4 × 1.2–1.6 mm), constricted to 5 mm diam. toward the apex; fertile portion 8.5–9 cm, drying 9–10 mm wide, bluntly pointed at the apex. INFRUCTESCENCES 1 per axil, erect, to 6 × 3.5 cm (dry); *peduncle* to 8 cm, pale green; spathe tube light green outside; *berries* greenish white; seeds cream-white, 0.7–1.1 × 0.6–1 mm, pyramidal with 9 acute longitudinal ridges or lemon-shaped with 12 acute longitudinal ridges.

Distribution and habitat. The species is endemic to Colombia, occurring in the Bajo Calima region, on the Pacific Andean slopes of Colombia, Departments of Valle and Chocó, in Tropical rainforest transition to Premontane (T-rf/P), at about 30–50 m. It was collected in older regrowth forest.

Phenology. *Xanthosoma hebetatum* was collected in fruit in July in the Bajo Calima region.

Xanthosoma hebetatum is characterized by its ovate blades, which are subhastate at the base and matte (appearing almost glaucous, hence the epithet from the Latin "hebetatus," meaning matte) on the lower surface. It differs from *X. guttatum* in being a smaller plant with ovate-subhastate leaves that are matte with sunken major veins on the upper surface.

IUCN Red List category. Conservation status for *Xanthosoma hebetatum* must be considered as LC (Least Concern) according to IUCN criteria (IUCN, 2001), because it is known from three collections in both Chocó and Valle Departments and because plants of this size are rarely collected.

Paratypes. COLOMBIA. **Choco:** ca. 10–15 km S of Quibdó on rd. to Istmina (Panamerican Hwy.), 8–10 km E on rd. to petroleum exploration camp, 90 m, 9 July 1986, *Grayum, Hammel, Kress & G. Brown* 7655 (MO). **Valle:** Buenaventura–Málaga rd., Km 11.5, *Croat & Gaskin 79778* (CUVC, MO); Municipio Buenaventura, Corregimiento Chancos, Campamento CVC, via Dos Quebrados, *W. Devia A & F. Prado 2432* (TULV, US).

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Emmotum harleyi, a New Species from Bahia, Brazil, and Lectotypification of Other Icacinaceae

Rodrigo Duno de Stefano and Diego F. Angulo

Herbarium CICY, Centro de Investigación Científica de Yucatán A.C., Calle 43, No. 130, Col. Chuburná de Hidalgo, 97200 Mérida, Yucatán, México. roduno@cicy.mx; dangulo@cicy.mx

Fred W. Stauffer

Conservatoire et Jardin botaniques de la Ville de Genève, Case postale 60, CH-1292 Chambésy/Genève, Switzerland. fred.Stauffer@ville-ge.ch

Abstract. *Emmotum harleyi* R. Duno (Icacinaceae), a new species of *Emmotum* Desvaux, is described, illustrated, and compared with *E. nitens* (Bentham) Miers. This new species from Bahia, Brazil, is distinguished by leaves densely tomentose abaxially with large and crisped hairs, secondary nerves 9 to 11, and ovary glabrous. Furthermore, lectotypes for *E. nitens* (Bentham) Miers and *Mappia racemosa* Jacquin var. *brachycarpa* Grisebach are designated.

Key words: Bahia, Brazil, *Emmotum*, Icacinaceae, IUCN Red List, lectotype, *Mappia*.

Emmotum Desvaux is a small genus in the Icacinaceae with 11 recognized species, including seven in Brazil. The genus occurs in Colombia, Venezuela, Guyana, Suriname, French Guiana, Peru, Brazil, and Bolivia. Four regional taxonomic revisions of the genus have been published (Engler, 1897; Carvalho et al., 1973; De Roon, 1994; Howard & Duno de Stefano, 1999), and only one complete monograph was published, more than 60 years ago (Howard, 1942b). One of the most common species, *E. nitens* (Benthan) Miers, grows in cerrado vegetation across the Central Brazilian Plateau and the Mato Grosso Plateau, extending from Brazil into Bolivia and reaching the Amazonian basin in the north. *Emmotum nitens* is characterized by petals with a continuous band of hairs along the midvein on the inner surface, stamens with the connective broadly ovate and slightly prolonged at the apex, and a short style. When studying herbarium specimens referred to *E. nitens* (AAU, B, BM, F, G, GH, INPA, K, M, MO, NY, P, SPF, and US), a distinct set of populations was detected that differ in morphology and ecological features and therefore require taxonomic recognition.

Emmotum harleyi R. Duno, sp. nov. TYPE: Brazil. Bahia: 19.5 km SE of Morro do Chapéu on BA052 rd. to Mundo Novo, by Rio Ferro Doido, ca. 900 m, ca. 11°38′S, 41°02′W, 2 Mar. 1977 (fl), *R. M. Harley, S. J. Mayo, R. M. Storr, T. S. Santos & R. S. Pinheiro 19248* (holotype, K; isotypes, K, NY). Figure 1.

Species haec *Emmoto nitenti* (Bentham) Miers similis sed foliis subtus dense tomentosis, pilis longioribus, erectis, crispatis non adpressis rectis, ovariis glabris non hirsutis recedit.

Shrub to small tree up to 5 m high; young branches tomentose, persistent, trichomes of icacinaceous hairs, simple, articulate at base. *Leaves* coriaceous, sharply bicolored, dark green and shiny adaxially, yellow or golden abaxially; petioles 1.3–1.5 cm, sulcate, tomentose; blade elliptic or widely elliptic, rarely ovate or narrowly ovate, 5–10 × 3–4.5 cm; apex acute, rarely acuminate, attenuate, shortly acuminate or emarginate; margin entire, slightly revolute; base rounded; nervation penninerved, camptodromous, 9 to 11 pairs of secondary nerves, alternate, well developed but hidden by a dense indument; adaxially glabrous; abaxially densely tomentose with crisped hairs ca. 0.2 mm. *Inflorescences* to 4 cm, axillary, paniculate, 1- to 4-floriferous branches per axil, all parts densely tomentose; peduncle short, to 2 cm, tomentose; bracts narrowly triangular, 3 mm, tomentose outside, glabrous inner surface; bracteoles 1 or 2, narrowly triangular, 1 × 0.1 mm, tomentose outside, glabrous inner surface. *Flowers* 5-merous, articulate at base, slightly fragrant; calyx campanulate, slightly fleshy, lobes triangular, 1 mm long, tomentose outside, glabrous inner surface; corolla with white petals, slightly retrorse or erect at anthesis, slightly fleshy, ovate or narrowly ovate, 2.5–3 × 1 mm, sericeous outside, slightly bearded on the inner surface, with large, undulate hair to 0.5 mm; stamens 2.5–3 mm, filament 1.5–1.8 mm, basally dilated, glabrous; anthers 1 mm, basifixed; connective broadly ovate, slightly prolonged at the apex; pistil subglobose, 1.8–2.5 mm high, glabrous; style terminal, very short, only 0.5 mm or less; stigma diminute,

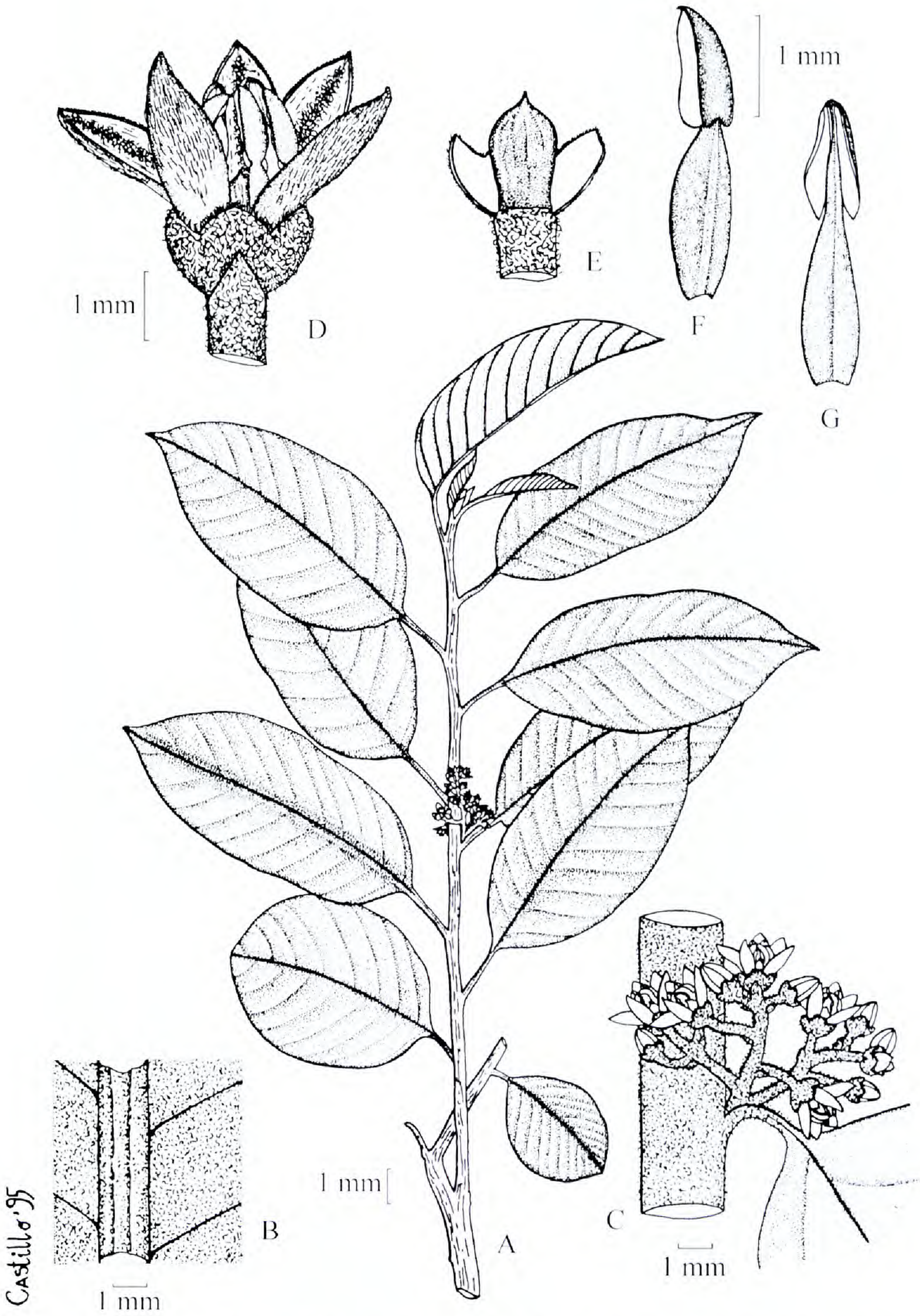

Figure 1. *Emmotum harleyi* R. Duno. —A. Habit. —B. Detail of the leaf indument (abaxial surface). —C. Detail of the inflorescence. —D. Flower. —E. Detail of the pistil. —F. Stamen, outside surface. —G. Stamen, inner surface. Drawn from the holotype, *Harley et al. 19248* (K).

capitate. *Fruit* 1 to 2(3) per infructescence, drupe, depressed-globose, 1–1.2 cm, 1–1.5 cm diam., the apex short or mucronate, 3 locules, each 1-seeded, sparingly pilose, becoming glabrate, with heavy stony endocarp, sutures not developed, but rugose or sculptured outside.

Etymology. The plant is named to honor R. M. Harley (1936–), who worked for many years and gathered many collections in the Chapada Diamantina, especially in the Mucugê area where the new species is found.

Distribution and ecology. *Emmotum harleyi* is only known from the Chapada Diamantina including the Serra do Tombador in Bahia, Brazil. It grows mainly in campo rupestre over white crystalline sand rock, between 800 and 1200(–1450) m and, more rarely, on mata ciliar at 500 m. The plants flower from September to July, with fruits from September to June.

IUCN Red List category. The information about the population status of this species is far from complete to produce a precise conservation evaluation, but some general information can be gathered from the specimen's label. *Emmotum harleyi* occurs along discontinuous extensions in an area of ca. 100,000 km^2. There are numerous botanical collections, including some made inside protected areas of Bahia such as Parque Municipal de Mucugê, P. M.

Natural Pico das Almas, Parque Nacional da Chapada Diamantina, and Santuário Ecológico do Largo do Queiroz, among others. Despite the cerrado and campo rupestre being two of the most threatened ecosystems in northeastern Brazil, the population of this species seems to be large enough to be excluded from any category of protection according to IUCN criteria (IUCN, 2001).

Vernacular name. Aderno (*Melo et al. 1636*).

Relationships. The proposed new taxon is similar to *Emmotum nitens*, but the abaxial surface of the leaves has long, erect, and crisped hairs, instead of short, appressed, straight hairs. The flowers have the inner surface of the petals with a continuous band of hairs along the midvein instead of two tufts of hairs at the base and the apex; the ovary is glabrous and not hirsute. The new species occupies a different habitat and a different geographical area of distribution. *Emmotum harleyi* occurs at the eastern edge of the distribution of *E. nitens*, in Chapada Diamantina, Bahia, where it grows in campo rupestre vegetation over white crystalline sand rock, between 900 and 1400 m. In contrast, *E. nitens* is found between 300 and 900 m in cerrado vegetation on clay soils in the states of Bahia, Distrito Federal, Goias, Minas Gerais, and Pernambuco in Brazil and the departments of Beni, La Paz, and Santa Cruz in Bolivia. Another related species, *E. orbiculatum* (Bentham) Miers, occurs in the Amazon basin and is distinguished by its orbicular leaves.

Paratypes. BRAZIL. **Bahia:** Mun. Morro do Chapéu, 4 km de Morro do Chapéu, na estrada a Utinga, 26 Mar. 1996, *M. L. Guedes, E. Woodgyer & B. Stannard 2570* (SPF); Mun. Mucugê, área antropizada, 31 Jan. 1997, *M. L. Guedes, B. Stanndar, S. Atkins, E. Saar & L. Passos 4750* (K, SPF); 4 km S of Mucugê, on rd. from Cascavel by Rio Cumbuca, 6 Feb. 1974, *R. M. Harley, S. A Renvoize, C. M. Erskine, C. A. Brighton & R. Pinheiro 16055* (K, NY); 4 km S of Mucugê, on rd. from Cascavel by Rio Cumbuca, 6 Feb. 1974, *R. M. Harley, S. A. Renvoize, C. M. Erskine, C. A. Brighton & R. Pinheiro 16056* (K); betw. 2.5 and 5 km S of Vila do Rio de Contas on side rd. to W of the rd. to Livramento, 28 Mar. 1977, *R. M. Harley, S. J. Mayo, R. M. Storr, T. S. Santos & R. S. Pinheiro 20136* (NY, US); Mun. Rio de Contas, 2–9 km da cidade na estrada a Arapiranga (furna) para o aeroporto, *R. M. Harley, M. C. Assis & F. S. Pires 26113* (MO, NY); Mun. Rio de Contas, Pico das Almas, vertente leste, Perto da Faz. Brumadinho, 16 km ao NO da cidade, 27 Nov. 1988, *R. M. Harley & N. Taylor 27010* (NY, SPF); Mun. Lençóis, Serra da Chapadinha, entre Chapadinha e Brejões, 21 Feb. 1995, *E. Melo, M. Sena & M. França 1636* (SPF); Mun. Rio de Contas, Barra do Brumado, 25 July 1978, *S. A. Mori, T. S. dos Santos & I. White 10310* (A, NY); Mun. de Lençóis, arredores de Lençóis, caminho para Barro Branco, 1 Nov. 1979, *S. A. Mori 12940* (A, NY); Mun. de Andarai, Nova Rodovia Andarai/Mucugê, a 15–20 km ao S de Andarai, 21 Dec. 1979, *S. A. Mori & F. P. Benton 13119* (A, NY); Mun. de Lençois, BR 242, Km 214, entrada na antiga estrada para Lençóis, 12 km ao N de Lençois, 29 Feb. 1980, *S. A. Mori 13320* (A, NY); Mun. de Mucujê, a 6 km ao SW de Mucugê, 04 Mar. 1980, *S. A. Mori 13410* (A, NY); Mun. de Rio de Contas, Serra das Almas, a 5 km ao NW de Rio de Contas, 21 Mar. 1980, *S. A. Mori & F. Benton 13526* (A, NY).

Lectotypification of Some Species of the Family Icacinaceae

There are some species of the family Icacinaceae that need to be lectotypified to increase the nomenclatural precision. Such is the case of *Emmotum nitens* and *Mappia racemosa* Jacquin var. *brachycarpa* Grisebach. In concordance with the *International Code of Botanical Nomenclature* (McNeil et al., 2006), a lectotype for each taxa is proposed.

Lectotypification of *Emmotum nitens*

This species was originally described by George Bentham (1800–1884) as a member of the genus *Pogopetalum*. Bentham used one collection of *George Gardner 3309* from Brazil as type material, and two sheets were deposited at Kew. We chose the collection with flowers as the lectotype of *Emmotum nitens*. Also, *E. faia* Kuhlmann is included here as a synonym; even though the type was not studied, its description and illustration correspond to *E. nitens*.

Emmotum nitens (Bentham) Miers, Ann. Mag. Nat. Hist., ser. II, 10: 180. 1852. Basionym: *Pogopetalum nitens* Bentham, London J. Bot. 2: 377. 1843. TYPE: Brazil. Goias: *G. Gardner 3309* (lectotype, designated here, K; isotypes, G, K [2], NY).

Emmotum faia Kuhlmann, Arch. Jard. Bot. Rio de Janeiro XXVI: 45. 1982. Syn. nov. TYPE: Brazil. Espíritu Santo: "ad marginis Lagoa do Durão, Rio Doce," 12 May 1934, *J. G. Kuhlmann 177* (holotype, RB).

Lectotypification of *Mappia racemosa* var. *brachycarpa*

Mappia Jacquin is a genus of the Icacinaceae with four or five species. The genus occurs from Mexico to Panama and in the Antilles. *Mappia racemosa* is the most common species in the Antilles and has two varieties (Howard, 1942a). Grisebach described *M. racemosa* var. *brachycarpa* in his *Plantae Wrightianae* (1860), using two collections made by Charles Wright (numbers 1389 and 1578) as type material, but without indication of the herbarium where these specimens were stored. Here, we propose one of these syntypes deposited at GOET as the lectotype for the species. The collection *C. Wright 1389* is chosen because the original description mentioned a plant with flowers and fruits, congruent with the specimen at GOET. Borhidi (1983) previously elevated this variety to the rank of subspecies without further explanation. We are still studying the botanical material of the Greater Antilles to

evaluate any correlation between morphological variation and any geographical or ecological differentiation.

Mappia racemosa Jacquin var. **brachycarpa** Grisebach, Pl. Wright. 8: 119. 1860. *Mappia racemosa* subsp. *brachyarpa* (Grisebach) Borhidi, Acta Bot. Hung. 29: 185. 1983. TYPE: Cuba. *Ch. Wright 1389* (lectotype, designated here, GOET; isotypes, GH, HAC, K, MA, MO [2], NY).

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Studies of New Zealand Hepaticae. 20–38. A Miscellanea of New Taxa and Combinations

John J. Engel
Department of Botany, The Field Museum, Chicago, Illinois 60605-2496, U.S.A.
jengel@fieldmuseum.org

Abstract. The following new infrageneric taxa are described: *Bazzania* S. Gray sect. *Glaucobazzania* J. J. Engel (Lepidoziaceae) and *Cephalozia* (Dumortier) Dumortier subg. *Eocephalozia* R. M. Schuster ex J. J. Engel (Cephaloziaceae). *Solenostoma cryptogynum* R. M. Schuster ex J. J. Engel (Jungermanniaceae), *C. austrigena* R. M. Schuster ex J. J. Engel, *C. schusteriana* J. J. Engel, *C. pachygyna* R. M. Schuster ex J. J. Engel (Cephaloziaceae), *Cephaloziella pseudocrassigyna* R. M. Schuster ex J. J. Engel (Cephaloziellaceae), and *Hyalolepidozia microphylla* R. M. Schuster ex J. J. Engel (Lepidoziaceae) are new species. *Kurzia helophila* R. M. Schuster var. *flaccida* R. M. Schuster ex J. J. Engel and *Allisoniella nigra* (Rodway) R. M. Schuster var. *acutiloba* J. J. Engel are new varieties. *Lophozia monoica* (Hodgson) J. J. Engel, *Andrewsianthus hodgsoniae* (R. M. Schuster) R. M. Schuster ex J. J. Engel, *A. scabrellus* (C. Massalongo) R. M. Schuster ex J. J. Engel, *A. sphenoloboides* (R. M. Schuster) R. M. Schuster ex J. J. Engel, *Solenostoma hodgsoniae* (Grolle) J. J. Engel, *S. rufiflorum* (Colenso) J. J. Engel, *Pseudomarsupidium aureocinctum* (R. M. Schuster) J. J. Engel, *P. crossii* (Spruce) J. J. Engel, and *Cephaloziella varians* (Gottsche) Stephani var. *subantarctica* (R. M. Schuster) R. M. Schuster ex J. J. Engel are new combinations.

Key words: *Andrewsianthus*, Hepaticae, *Hyalolepidozia*, IUCN Red List, New Zealand, *Pseudomarsupidium*, *Solenostoma*.

A number of new taxa and combinations in the Hepaticae have surfaced during preparation of the first volume of *A Flora of the Liverworts and Hornworts of New Zealand* (Engel & Glenny, in press). These are published here so that they may be made immediately available for use, and their taxonomic numbering corresponds to presentation in earlier papers in this series (Engel & Schuster, 1988, 1994; Engel & Smith Merrill, 1994, 1996). All of the new taxa and combinations, except those in *Andrewsianthus* R. M. Schuster and *Pseudomarsupidium* Herzog, are restricted to New Zealand. *Andrewsianthus scabrellus* (C. Massalongo) R. M. Schuster ex J. J. Engel and *A. sphenoloboides* (R. M. Schuster) R. M. Schuster ex J. J. Engel occur in southern South America, *Pseudomarsupidium aureocinctum* (R. M. Schuster) J. J. Engel is endemic to Venezuela, and *P. crossii* (Spruce) J. J. Engel is known only from Colombia and Venezuela. The new species in this contribution are all designated as DD (Data Deficient) according to IUCN Red List criteria (IUCN, 2001).

Lepidoziaceae Limpricht

20. Bazzania Gray sect. **Glaucobazzania** J. J. Engel, sect. nov. TYPE: *Bazzania tayloriana* (Mitten) Kuntze.

Superficies folii glauca, dense leviterque punctato-glandularis, in statu madido hebes lactea opaca.

Plants with leaf surface glaucous, densely and finely punctate-granular, dull, milky and opaque when moist.

To my knowledge, the section contains only the type species, *Bazzania tayloriana*, of New Zealand.

21. Hyalolepidozia microphylla R. M. Schuster ex J. J. Engel, sp. nov. TYPE: New Zealand. South Island: Fiordland, Hunter Mtns., Mt. Burns, 4500–5000 ft., *R. M. Schuster 84-101b* (holotype, Hb. Schuster not seen).

Hyalolepidoziae bicuspidatae (C. Massalongo) S. W. Arnell ex Grolle similis, sed lobis folii in cellulam unicam terminantibus, foliis sporadice 3-lobis, pariete capsulae bistratoso, statu sexuali dioico differt.

Plants are similar to *Hyalolepidozia bicuspidata* (C. Massalongo) S. W. Arnell ex Grolle, but differ in leaf lobes terminating in a single cell, leaves sporadically 3-lobed, the capsule wall bistratose, and the presence of a dioecious condition.

The name appeared as *Hyalolepidozia microphylla* R. M. Schuster, Nova Hedwigia Beih. 118: 387, f. 155, 156. 2000, nom. nud., sine descr. Latin.

22. Kurzia helophila R. M. Schuster var. **flaccida** R. M. Schuster ex J. J. Engel, var. nov. TYPE: New Zealand. South Island: Fiordland Nat. Park, track

from Lake Mackenzie to Harris Saddle, *R. M. Schuster 67-3908* (holotype, Hb. Schuster not seen).

Folia usque 0.4–0.55 partem folii quadrifida; discus per proceritatem 9 ad 11(12) cellulorum distinctus; cellulae laminares folii quoad magnitudinem ex base foliari usque ad dimidia basalia loborum subaequantes; cellulae corticales in axe principali usque ad series 16 attingentes.

Stem of main axis with cortical cells in up to 16 rows. Leaves quadrifid to 0.4–0.55; disc 9–11(12) cells high; cells of leaf lamina subequal in size from base into basal halves of lobes.

The name initially appeared as *Kurzia helophila* R. M. Schuster var. *flaccida* R. M. Schuster, Nova Hedwigia Beih. 118: 259. 2000, nom. nud.

JUNGERMANNIACEAE REICHENBACH

23. Lophozia monoica (Hodgson) J. J. Engel, comb. nov. Basionym: *Metahygrobiella monoica* Hodgson, Trans. Roy. Soc. New Zealand, Bot. 3: 76. 1965. TYPE: New Zealand. South Island: Fiordland, mtns. above Nancy Sound, 3600 ft., Jan. 1963, *C. J. Burrows s.n., hb. Hodgson 12548* (holotype, MPN).

The species is transferred from *Metahygrobiella* R. M. Schuster to *Lophozia* (Dumortier) Dumortier on the basis of the presence of leaves with succubous insertion and orientation, stem cortical cells similar to or a little smaller than the medullary, presence of mycorrhizal fungi in stem cells, leaf cells with distinct trigones, and presence of underleaves. This contrasts with leaf insertion transverse, at least in dorsal sector; stem cortical cells typically larger than the medullary; absence of mycorrhizae in stem cells; leptodermous leaf cells and total absence of trigones; and absence of underleaves as seen in *Metahygrobiella*.

24. Andrewsianthus hodgsoniae (R. M. Schuster) R. M. Schuster ex J. J. Engel, comb. nov. Basionym: *Cephalolobus hodgsoniae* R. M. Schuster, Rev. Bryol. Lichénol. 34: 254. fig. 1. 1966, as "*hodgsonae*." TYPE: New Zealand. South Island: Mt. Cook Natl. Park, Sealy Range, above Sealy Lakes, ca. 4500–4900 ft., *R. M. & O. Schuster 49702* (holotype, Hb. Schuster not seen).

The genus *Cephalolobus* R. M. Schuster (Schuster, 1966) was accorded subgeneric status under *Andrewsianthus* by Schuster (2002). Three species require transfer to *Andrewsianthus*, the New Zealand endemic *A. hodgsoniae*, and the two species from southern South America indicated below.

25. Andrewsianthus scabrellus (C. Massalongo) R. M. Schuster ex J. J. Engel, comb. nov. Basionym: *Cephalozia scabrella* C. Massalongo, Nuovo Giorn. Bot. Ital. 17: 233, pl. 20, f. 19. 1885. *Sphenolobus scabrellus* (C. Massalongo) Stephani, Spec. Hep. 2: 162. 1902. *Cephalolobus scabrellus* (C. Massalongo) R. M. Schuster, Rev. Bryol. Lichénol. 34: 250. 1966. TYPE: Argentina. Tierra del Fuego: Isla de los Estados, "Port Cook and Port St. John," 1882, *C. Spegazzini* (lectotype, designated by Schuster, 1966: 251, G not seen).

The species is restricted to southern South America and the Falkland Islands (see Engel, 1990).

26. Andrewsianthus sphenoloboides (R. M. Schuster) R. M. Schuster ex J. J. Engel, comb. nov. Basionym: *Cephalolobus sphenoloboides* R. M. Schuster, Rev. Bryol. Lichénol. 34: 251. 1966. TYPE: Chile. Isla Desolacion: Puerto Angosto, 28 Mar. 1896, *P. Dusén 177* (holotype, G not seen).

The species is restricted to Tierra del Fuego and the Brunswick Peninsula, Strait of Magellan (see Engel, 1978).

SOLENOSTOMA MITTEN

The new species below (no. 27), together with the two new combinations in *Solenostoma* made below, are placed in the genus *Solenostoma* rather than *Jungermannia* L. because of the presence of (1) a low perigynium, except in *S. rufiflorum* (Colenso) J. J. Engel, (2) reddish to vinaceous pigmentation, and (3) lateral-intercalary branches (see Schuster, 2002).

27. Solenostoma cryptogynum R. M. Schuster ex J. J. Engel, sp. nov. TYPE: New Zealand. North Island: South Auckland Prov., Whirinaki Forest Park, rd. to Arahaki Lagoon, SSW of Minginui, 380 m, *J. J. Engel 20730* (holotype, F; isotype, CHR).

Solenostomati orbiculato similis sed perianthiis juventute lateraliter compressis, aetate in bracteis inclusis, foliis subtransverse dispositis, marginibus eorum dorsalibus ventralibusque non decurrentibus, cellulis medianis 46–61 μm latis × 50–72 μm longis, cellulis in regione distali isodiametricis, 35–46 μm latis longisque distinguenda.

Plants are similar to *Solenostoma orbiculatum* (Colenso) R. M. Schuster, but differ in perianths that are laterally compressed when young, and included with bracts at maturity; leaves subtransversely oriented, the dorsal and ventral margins not decurrent;

median cells are 46–61 µm wide × 50–72 µm long, the cells in distal sector are isodiametric, 35–46 µm wide and long.

The name initially appeared as *Solenostoma cryptogynum* R. M. Schuster, Beih. Nova Hedwigia 119: 380, 381, fig. 355: 5–11, 356. 2002, nom. nud., sine descr. Latin.

28. Solenostoma hodgsoniae (Grolle) J. J. Engel, comb. nov. Basionym: *Jungermannia hodgsoniae* Grolle, Bot. Mag., Tokyo 78: 83. 1965, replaced name for *Lethocolea grandifolia* Berggren, On New Zealand Hep. 1: 26, f. 19. 1898. *Symphyomitra grandifolia* (Berggren) Stephani, Spec. Hep. 2: 107. 1901. *Jungermannia grandifolia* (Berggren) Hodgson, Trans. Roy. Soc. New Zealand 85: 582. 1958 non *J. grandifolia* Hooker f. & Taylor, London J. Bot. 3: 474. 1844 (= *Leptoscyphus horizontalis* (Hooker) Kühnemann). TYPE: New Zealand. South Island: Westland Prov., Teremakau River, betw. Blake's and Kelly's, Mar. 1874, *S. Berggren 3140* (lectotype, designated by Váňa, 1975: p. 306, LD not seen; duplicate, G).

29. Solenostoma rufiflorum (Colenso) J. J. Engel, comb. nov. Basionym: *Jungermannia rufiflora* Colenso, Trans. Proc. New Zealand Inst. 18: 237. 1886. TYPE: New Zealand. North Island: Waipawa Co., near Norsewood, 1885, *W. Colenso a.1361* (lectotype, designated by Váňa, 1975: 302, WELT [cum sporo.]; duplicate, G [cum sporo.]).

Adelanthaceae (Joergensen) Grolle

30. Pseudomarsupidium aureocinctum (R. M. Schuster) J. J. Engel, comb. nov. Basionym: *Adelanthus decipiens* (Hooker) Mitten subsp. *aureocinctus* R. M. Schuster, Phytologia 39: 250. 1978. *Adelanthus aureocinctus* (R. M. Schuster) R. M. Schuster, Nova Hedwigia Beih. 119: 178. 2002. TYPE: Venezuela. Estado Merida: Sierra Nevada de Merida, ca. 2000 m, *Schuster & L. Ruiz-Terán 76-1920* (holotype, Hb. Schuster not seen).

The species is endemic to Venezuela; *Pseudomarsupidium piliferum* (Stephani) Herzog ex Grolle occurs in New Zealand, Australia (Tasmania, Victoria, N.S.W.), New Caledonia, southern Chile, Juan Fernandez, Inaccessible Island, and Nightingale Island.

This species and the next are transferred from *Adelanthus* Mitten to *Pseudomarsupidium* on the basis of the presence of two strong spiniferous teeth at the leaf apex, the stem cortical cells in 1(2) layers of at most moderately thick-walled cells, and the absence of gemmae. In *Adelanthus* leaf apices are variously toothed but not bidentate, stem cortical cells are in 2–3 layers of notably thick-walled cells with reduced lumina, and gemmae are frequently developed.

31. Pseudomarsupidium crossii (Spruce) J. J. Engel, comb. nov. Basionym: *Adelanthus crossii* Spruce, Proc. Bot. Soc. Edinburgh 15: 404. 1885. TYPE: Colombia. "Prope Popayan," *R. Cross* (holotype, MANCH not seen).

The species is known only from Colombia and Venezuela.

Cephaloziaceae Migula

32. Cephalozia (Dumortier) Dumortier subg. **Eocephalozia** R. M. Schuster ex J. J. Engel, subg. nov. TYPE: *Cephalozia badia* (Gottsche) Stephani.

Plantae plerumque quoad colorem rubrescentes vel brunnescentes; rami et frullaniformes et ventraliter intercalares, ramis lateraliter intercalaribus nullis; folia dorsaliter ad linea media caulis inserta; gemmae semper nullae; gynoecia in caulibus longis vel ramis ventraliter intercalaribus disposita.

Plants usually with reddish or brownish pigments; branches of *Frullania* and ventral-intercalary types, with lateral-intercalary branches lacking; leaves inserted to stem midline dorsally; gemmae always lacking. Gynoecia on long shoots or short ventral-intercalary branches.

The subgenus contains *Cephalozia badia* of the South Sandwich Islands, South Orkney Islands, South Shetland Islands, west Antarctic Peninsula, South Georgia, Falkland Islands, southern South America, and New Zealand; *C. schusteriana* J. J. Engel and *C. pachygyna* R. M. Schuster ex J. J. Engel of New Zealand and *C. chilensis* (J. J. Engel & R. M. Schuster) R. M. Schuster of southern South America.

33. Cephalozia austrigena R. M. Schuster ex J. J. Engel, sp. nov. TYPE: New Zealand. South Island: Mt. Aspiring Natl. Park, Mt. Brewster, NE of Haast River, ca. 4200 ft., *R. M. Schuster 67-451d* (holotype, Hb. Schuster not seen).

Insertio folii usque ad prope lineam medianam caulis non extensa, zona continua cellularum corticalium efoliata praesenti; plantae sub sole habitantes colore vivide vinaceo vel carmineo tingentes; caulis hyalodermidem formans cellulis corticalibus dorsalibus lateralibusque valde inflatis multum

maioribus quam cellulis medullae ornatam; gemmae praesentes; lobi folii ad basem latitudine e cellulis 4 ad 5 composita; gynoecia in axibus quoad longitudinem variabilibus, aliquae in ramos ventrales breves disposita.

Plants (in sun) intense vinaceous to carmine; stem with a hyaloderm, the dorsal and lateral cortical cells strongly inflated, much larger than medullary cells; leaves with insertion not extending to near stem midline, a continuous band of cortical cells present and leaf-free; leaf lobes 4–5 cells wide at base; gemmae present. Gynoecia on axes of variable length, some on short ventral branches.

The name appeared in the literature as follows: *Cephalozia bicuspidata* (L.) Dumortier subsp. *austrigena* R. M. Schuster, Hep. Anthoc. N. Amer. 3: 712. 1974, nom. inval., sine descr. Latin. *Cephalozia austrigena* R. M. Schuster, Nova Hedwigia Beih. 119: 29, f. 222. 2002, nom. inval., typ. et herb. non. cit.

The species, endemic to New Zealand, is raised to the species rank to distinguish it from *Cephalozia bicuspidata*; it belongs to subgenus *Cephalozia*.

34. Cephalozia schusteriana J. J. Engel, sp. nov. TYPE: New Zealand. South Island: Canterbury Prov., Arthur's Pass Natl. Park, Scotts Track to Avalanche Peak, W of town of Arthur's Pass, 1370–1430 m, *J. J. Engel 22067*, cum perianths + male (holotype, F; isotype, CHR).

Plantae sub sole habitantes brunneae vel purpurascentes; cellulae corticales caulis in series 11 ad 13 dispositae, plusminusve parietibus firmis, leviter vel moderatim maiores quam cellulae medullares; insertio folii dorsaliter usque ad lineam medianam caulis extensa; amphigastria in caulibus sterilibus in locis discretis effecta, magna; gemmae nullae; os perianthii ciliolatum, dentibus numerosis brevibus liberis e cellulis (1)2–4 elongatis (2–4.5:1) compositis armatum; basis perianthii 1- ad 2-stratosa.

Plants (in sun) brown to purplish; stem cortical cells in 11–13 rows, ± firm-walled, slightly to moderately larger than those of the medulla; leaf insertion extending to stem midline dorsally; underleaves locally developed on sterile shoots, large; gemmae lacking. Perianth mouth ciliolate with numerous short, free teeth composed of (1)2–4 elongated cells (2–4.5:1); perianth base 1- to 2-stratose.

This species appears to be the same as "*Cephalozia ciliolata*," which is twice mentioned by Schuster (2002), once in the key (p. 25) and again in text (p. 29). However, since there is no description, illustration, or citation of a specimen in Schuster (2002), I cannot be certain of the identity of this manuscript name.

35. Cephalozia pachygyna R. M. Schuster ex J. J. Engel, sp. nov. TYPE: New Zealand. South Island: Fiordland, *R. M. Schuster 84-138* (holotype, Hb. Schuster not seen).

Plantae sub sole habitantes brunneae vel purpurascentes; insertio folii dorsaliter usque ad lineam medianam caulis extensa; cellulae corticales caulis in 12 ad 13 series dispositae, tantum parum maiores quam cellulae medullares; lobi folii ad basem quoad latitudinem e 8 ad 10 cellulis compositi, in cellulam singulam vel in series uniseriatas e 2 cellulis compositas terminantes, cellulis apicalibus leniter longioribus quam latioribus; amphigastria in caulibus sterilibus nulla; reproductio asexualis nulla; plantae autoicae; bracteae usque ad ca. 0.35 partem longitudinis bilobae; os perianthii crenulatum cellulis parum elongatis (usque 2:1); basis perianthii 4- ad 6-stratosa.

Plants (in sun) brown to purplish; stem cortical cells in 12–13 rows, only slightly larger than medullary cells; leaves with insertion extending to stem midline dorsally; leaf lobes 8–10 cells wide at base, terminating in a single cell or a uniseriate row of 2 cells, the tip cells slightly longer than wide; underleaves lacking on sterile shoots; asexual reproduction lacking. Plants autoecious; gynoecial bracts bilobed to ca. 0.35; perianth mouth crenulate, with little-elongated cells (to 2:1); perianth base 4- to 6-stratose.

The name appeared in the literature as *Cephalozia pachygyna* R. M. Schuster, Nova Hedwigia Beih. 119: 25, 29. f. 220, 221. 2002, nom. nud.

CEPHALOZIELLACEAE DOUIN

36. Allisoniella nigra (Rodway) R. M. Schuster var. **acutiloba** J. J. Engel, var. nov. TYPE: New Zealand. Stewart Island: Bald Cone, *D. Glenny 9317* (holotype, F; isotype, CHR).

Plantae obscure lutescenti-brunneae vel fuscae; folia usque 0.35–0.5 partem folii bifida; lobi ad basem latitudine e cellulis 17 ad 24 composita, subacuti vel plusminusve acuti; status sexualis autoicus.

Plants dark yellowish brown to fuscous; leaves bifid to 0.35–0.5; leaf lobes 17–24 cells wide at the base, subacute to ± acute. Plants autoecious.

The new variety is assigned to subspecies *nigra* as described by Schuster (1971 [1972]).

37. Cephaloziella pseudocrassigyna R. M. Schuster ex J. J. Engel, sp. nov. TYPE: New Zealand. South Island: Fiordland Natl. Park, Mt. Burns, *R. M. Schuster 84-115* (holotype, Hb. Schuster not seen).

Plantae colorem viridem clarum translucentem lucidum tinctae, in partibus expositis ferrugineae; lobi folii aequantes; perianthium usque ad basem 1-stratosum, obtuse 5-plicatum, ore setuloso e cellulis plerumque 4–5.5:1 liberis ad

apices acuminatos angustos parietibus crassis praeditos composito.

Plants light clear translucent green, with exposed sectors rusty red; leaves with lobes equal. Perianth 1-stratose to base, bluntly 5-plicate, the mouth setulose with cells usually 4–5.5:1, free at their tapered, narrow, thick-walled apices.

The name appeared in the literature as *Cephaloziella pseudocrassigyna* R. M. Schuster, Nova Hedwigia 63: 48, f. 1: 12–14. 1996, nom. inval., herb. non cit.

38. Cephaloziella varians (Gottsche) Stephani var. **subantarctica** (R. M. Schuster) R. M. Schuster ex J. J. Engel, comb. nov. Basionym: *Cephaloziella arctica* Bryhn & Douin var. *subantarctica* R. M. Schuster, Nova Hedwigia 22: 197, pl. 15. 1971 [1972]. TYPE: New Zealand. South Island: Otago Prov., Old Man Range, near summit of "Old Man," 5300 ft., *R. M. Schuster 67-515a* (holotype, Hb. Schuster not seen).

The variety *subantarctica* was placed in *Cephaloziella arctica* by Schuster (1971 [1972]), but with placement of that species in the synonymy of *C. varians*, a realignment of variety *subantarctica* is necessary.

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New Sections, Combinations, and Varieties in Rosaceae, Potentilleae

Barbara Ertter

Curator of Western North American Botany, University and Jepson Herbaria, University of California, 1001 Valley Life Science Bldg. 2456, Berkeley, California 94720-2465, U.S.A., and Research Associate, Snake River Plains Herbarium, Boise State University, Boise, Idaho 83725-1515, U.S.A. ertter@calmail.berkeley.edu

James L. Reveal

Adjunct Professor, Department of Plant Biology, 228 Plant Science Building, Cornell University, Ithaca, New York 14853-4301, U.S.A., Honorary Curator, The New York Botanical Garden, Bronx, New York 10458, U.S.A., and Professor Emeritus, University of Maryland, College Park, Maryland 20742-5815, U.S.A. jlr326@cornell.edu

Abstract. Eight new sectional names are proposed in Rosaceae, tribe Potentilleae: *Horkelia* Chamisso & Schlechtendal sect. *Capitatae* (Rydberg) Ertter & Reveal, section *Hispidulae* Ertter & Reveal, and section *Parryae* Ertter & Reveal; *Ivesia* Torrey & A. Gray sect. *Comarella* (Rydberg) Ertter & Reveal, section *Saxosae* (Rydberg) Ertter & Reveal, section *Stellariopsis* (Baillon) Ertter & Reveal, and section *Unguiculatae* (Rydberg) Ertter & Reveal; and *Potentilla* L. sect. *Hippianae* (Rydberg) Ertter & Reveal. Thirteen varietial combinations are proposed: *Horkelia californica* Chamisso & Schlechtendal var. *elata* (Greene) Ertter & Reveal and variety *frondosa* (Greene) Ertter & Reveal; *H. clevelandii* (Greene) Rydberg var. *brevibracteata* (Wiggins) Ertter & Reveal; *H. cuneata* Lindley var. *puberula* (Rydberg) Ertter & Reveal and variety *sericea* (A. Gray) Ertter & Reveal; *H. daucifolia* (Greene) Rydberg var. *caruifolia* (Rydberg ex Howell) Ertter & Reveal and variety *indicta* (Jepson) Ertter & Reveal; *H. fusca* Lindley var. *brownii* (Rydberg) Ertter & Reveal (linked to significantly changed circumscriptions of variety *pseudocapitata* (Rydberg ex Howell) M. Peck and variety *capitata* (Lindley) M. Peck); *H. tridentata* Torrey var. *flavescens* (Rydberg) Ertter & Reveal; and *Ivesia gordonii* (Hooker) Torrey & A. Gray var. *alpicola* (Rydberg ex Howell) Ertter & Reveal and *ursinorum* (Jepson) Ertter & Reveal; and *I. lycopodioides* A. Gray var. *megalopetala* (Rydberg) Ertter & Reveal and variety *scandularis* (Rydberg) Ertter & Reveal. Two new varieties are proposed in *Ivesia*: *I. argyrocoma* (Rydberg) Rydberg var. *moranii* Ertter & Reveal, a taxon confined to the Sierra San Pedro Mártir of northern Baja California, Mexico, and *I. gordonii* var. *wasatchensis* N. H. Holmgren ex Ertter & Reveal of Idaho, Utah, Montana, and Wyoming. A key to the four varieties of *I. gordonii* is presented, and a lectotype is designated for *Horkelia gordonii* var. *alpicola* Rydberg ex Howell.

Key words: *Comarella*, *Horkelia*, *Ivesia*, *Potentilla*, Potentilleae, Rosaceae, *Stellariopsis*.

New sections, combinations, and varieties, presented below, are necessary for a treatment of various genera of Rosaceae Jussieu tribe Potentilleae Sweet in a forthcoming volume of *Flora of North America North of Mexico* (FNA). In our treatment, both *Horkelia* Chamisso & Schlechtendal and *Ivesia* Torrey & A. Gray are considered to be distinct from *Potentilla* L. following Keck (1938) with some modifications recently adopted by Ertter (1993) and Holmgren (1997), even though this results in a paraphyletic *Potentilla* in a strict sense. In the previous comprehensive treatments of Potentilleae in North America, Rydberg (1898) initially maintained *Ivesia* in *Horkelia* only to later accept both genera as distinct (Rydberg, 1908). He also recognized some entities (*Comarella* Rydberg and *Stellariopsis* Rydberg) at the generic level that Keck subsequently submerged into *Ivesia*. Some of the numerous unranked names proposed by Rydberg above the rank of species have been formally established at the rank of section by subsequent authors (e.g., Johnston, 1985); several more are likewise established herein.

Keys and full descriptions will be available in the *Flora* and are not repeated here (except for a key to the varieties of *Ivesia gordonii* (Hooker) Torrey & A. Gray). The distribution statements given here in some detail are based on our review of taxa for the FNA treatment and, in some cases, as noted, are novel.

New Sectional Names in *Horkelia*

Horkelia Chamisso & Schlechtendal sect. **Capitatae** (Rydberg) Ertter & Reveal, stat. nov. Basionym: *Horkelia* [unranked] *Capitatae* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 120, 122. 1898. TYPE: *Horkelia capitata* Lindley [= *H. fusca* Lindley var. *capitata* (Lindley) M. Peck].

Horkelia sect. *Capitatae* is monospecific, being circumscribed to include only *H. fusca* Lindley and its seven varieties, which occur in the far western United States. The section may be characterized as green or grayish, tufted plants with ascending to erect, glandular stems that are sparsely hairy. The basal leaves are planar with only slightly overlapping leaflets that are three to 15 per side and individually 5- to 15-toothed or -lobed. As the sectional name indicates, inflorescences are commonly capitate, at least in the more widespread varieties. Pedicels are straight and flowers are relatively small. The epicalyx bractlets are linear, and the sepals are often reflexed and streaked with purple. The hypanthium varies from turbinate to campanulate in shape and is glabrous within. The more or less triangular petals are white to pink and sometimes distinctly veined with pink to rose. The carpels are 10 to 25 in number, the style is distinctly glandular-thickened basally, and the mature achene is smooth.

Horkelia Chamisso & Schlechtendal sect. **Hispidulae** Ertter & Reveal, sect. nov. TYPE: *Horkelia hispidula* Rydberg.

Sectionis distinguibilis a plantis tegetes formantes cum caules 10–25 cm longis et achenis 1.5–2.5 mm longis.

Horkelia sect. *Hispidulae* is composed of three species confined to southern Oregon and California: *H. hendersonii* Howell, *H. hispidula*, and *H. tularensis* (J. T. Howell) Munz. When describing the last species, Howell (1966) noted its apparent connection to the other two species as possible relicts of a complex bordering interior basins. The section may be characterized as grayish or silvery green, densely matted plants with mostly ascending to erect, glandular stems that are silky hairy. The basal leaves are crowded and typically composed of overlapping leaflets that are four to 14 per side and divided individually into three to eight teeth or lobes. Inflorescences are congested but seldom capitate. Pedicels are straight. The epicalyx bractlets are linear to lanceolate with a cupulate hypanthium that is glabrous within. The petals are white. The carpels are five to 18 or rarely 20 in number, and the style is smooth. The resulting achene is also smooth.

Horkelia Chamisso & Schlechtendal sect. **Parryae** Ertter & Reveal, sect. nov. TYPE: *Horkelia parryi* Greene.

Sectionis distinguibilis a recurvatis pedicellis.

Horkelia sect. *Parryae* is composed of two species, *H. parryi* and *H. wilderae* Parish, both confined to California. The new section may be characterized as green, rosette-forming to openly matted plants with decumbent to slightly ascending, glandular and sparsely hairy stems. The basal leaves are planar and the three to seven leaflets do not overlap significantly, although each is divided into five to 15 lobes. Inflorescences are relatively open. Pedicels are distinctly recurved in fruit, which is the distinguishing feature of the section and unique within the genus. The epicalyx bractlets are linear-lanceolate to elliptic or rarely ovate with a cupulate to campanulate hypanthium that is glabrous or glandular within. The petals are white. The carpels are either three to four or vary typically from 20 to 50 in number, the style is smooth, and the mature achenes are finely reticulate or even rugose.

New Sectional Names in *Ivesia*

Ivesia Torrey & A. Gray sect. **Comarella** (Rydberg) Ertter & Reveal, comb. et stat. nov. Basionym: *Comarella* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 156. 1898. TYPE: *Comarella multifoliolata* (Torrey) Rydberg (lectotype, designated by Rydberg, N. Amer. Fl. 22: 291. 1908 [= *Ivesia multifoliolata* (Torrey) D. D. Keck]).

Ivesia sect. *Comarella* is composed of two species, *I. multifoliolata* and *I. sabulosa* (M. E. Jones) D. D. Keck. They are found in northern Arizona, southern Nevada, and southwestern Utah in the western United States. These are tufted, non-aromatic plants that have several ascending to erect stems and branches that are minutely glandular, often with microscopic, yellow, pellucid glands, and are more obviously villous proximally but hairless distally. The leaves are somewhat cylindrical with 12 to 40 overlapping leaflets per side. Pedicels may be straight or somewhat curved. The epicalyx bractlets are present on a shallowly campanulate to disciform hypanthium that is pentagonal in fruit. The five petals are often medially reflexed, a feature unique to the section. The stamens are always five with the filaments typically filiform, although some may be flattened. The carpels are one to five in number and horizontal rather than erect as elsewhere in the genus.

Ivesia Torrey & A. Gray sect. **Saxosae** (Rydberg) Ertter & Reveal, comb. nov. Basionym: *Horkelia* [unranked] *Saxosae* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 121, 125. 1898 [= *Potentilla* L. sect. *Saxosae* (Rydberg) B. C. Johnston, Phytologia 57: 299. 1985]. TYPE: *Horkelia saxosa* (Lemmon ex Greene) Rydberg [= *Ivesia saxosa* (Lemmon ex Greene) Ertter; basionym: *Potentilla saxosa* Lemmon ex Greene].

Ivesia sect. *Saxosae* is defined to encompass 11 species scattered throughout western North America, including those sometimes placed in *Purpusia* Brandegee or *Potentilla* sect. *Saxosae* (Rydberg) B. C. Johnston. These mostly aromatic plants are most often found confined to rock crevices, though sometimes cryptically so. The stems vary from prostrate or decumbent to spreading (rarely erect), and typically are glandular with scattered hairs. The microscopic pellucid glands are white to golden or reddish in color. The leaves are planar to cylindrical with one to 15 (rarely 18) separate to overlapping leaflets per side. Pedicels are usually recurved or even sigmoid especially when in fruit. The epicalyx bractlets are usually present on a shallowly campanulate to disciform hypanthium that is not pentagonal in fruit; bractlets are absent in *I. arizonica* (Eastwood ex J. T. Howell) Ertter and *I. patellifera* (J. T. Howell) Ertter. The petals are not medially reflexed. The stamens may be five or 15 to 35 (rarely 40) in number with more or less filiform filaments. Typically there are one to 20 (rarely up to 40) erect carpels.

Ivesia Torrey & A. Gray sect. **Stellariopsis** (Baillon) Ertter & Reveal, comb. nov. Basionym: *Potentilla* sect. *Stellariopsis* Baillon, Hist. Pl. 1: 370. 1869. TYPE: *Potentilla santolinoides* (A. Gray) Greene [= *Ivesia santolinoides* A. Gray, including *Stellariopsis santolinoides* (A. Gray) Rydberg].

Ivesia sect. *Stellariopsis* is a monospecific taxon that sometimes is treated at the generic rank (Rydberg, 1898). Its only species, *I. santolinoides*, is confined to the Sierra Nevada, Transverse Ranges, and San Jacinto Mountains of California. This is a tufted plant with several erect stems that are glandular and hairy proximally but often glabrous both distally and on the inflorescence branches. The infrequently seen microscopic pellucid glands are orangish or red to reddish purple in color. The leaves are cylindrical with 60 to 80 tightly congested leaflets per side. Pedicels are somewhat curved. The epicalyx bractlets are present on a disciform to funnelform hypanthium that is not pentagonal in fruit. The five petals are not medially reflexed. The stamens are 15 with mostly filiform filaments. There is only a single erect carpel. The anthers are as wide or wider than long with thecae that initially open by small, subterminal pores. This feature has been used to justify generic status, but fully opened thecae display a lateral suture typical of other members of *Ivesia*. A single carpel, consistent in *I. santolinoides*, may be found elsewhere but not consistently so (e.g., *I. rhypara* Ertter & Reveal). Finally, the branches, pedicels, and hypanthium have large, maroon-tipped capitate glands, a feature not otherwise known in *Ivesia*.

Ivesia Torrey & A. Gray sect. **Unguiculatae** (Rydberg) Ertter & Reveal, stat. nov. Basionym: *Horkelia* [unranked] *Unguiculatae* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 120. 1898. TYPE: *Horkelia unguiculata* (A. Gray) Rydberg [= *Ivesia unguiculata* A. Gray].

Ivesia sect. *Unguiculatae* is composed of eight species in the western United States with a single variety (*I. argyrocoma* var. *moranii* Ertter & Reveal) in northern Baja California, Mexico. These are tufted, scarcely aromatic plants with prostrate to erect stems that are mostly glandular and somewhat hairy. The pellucid glands are red to reddish purple in color. The leaves are cylindrical and congested at least apically with 15 to 60 leaflets per side. Pedicels are straight. The epicalyx bractlets are present on a cupulate, turbinate, or campanulate hypanthium that is not pentagonal in fruit. The five (rarely four) petals are not medially reflexed. The stamens are 10 to 20 in number with the filaments filiform to strongly flattened (e.g., *I. argyrocoma* (Rydberg) Rydberg). There are mostly two to 20 (rarely only one) erect carpels.

New Sectional Name in *Potentilla*

Potentilla L. sect. **Hippianae** (Rydberg) Ertter & Reveal, stat. nov. Basionym: *Potentilla* [unranked] *Hippianae* Rydberg, Bull. Torrey Bot. Club 24: 1. 1897. TYPE: *Potentilla hippiana* Lehmann.

Potentilla sect. *Hippianae* is a taxon of four species with both *P. hippiana* and *P. effusa* Douglas ex Lehmann widespread in the Rocky Mountains and on the Great Plains of western North America. More restricted in distribution are *P. ambigens* Greene and *P. crinita* A. Gray, as both are found mainly in the Rocky Mountains from Wyoming to New Mexico, with the latter extending westward into northern Arizona, portions of eastern Utah, and in the Spring Mountains

and Sheep Range of southern Nevada. The section may be characterized as those perennial members of *Potentilla* in the southwestern United States with tomentose, eglandular, ascending to erect stems, pinnately divided leaves with five to 15 leaflets that are strigose or sericeous on both surfaces or white-tomentose abaxially, and relatively straight (not recurved) pedicels. The leaflets are toothed no more than half the distance to the midrib. The stamens are mainly 20 (rarely 25) in number, and the carpels are 15 to many with a filiform style subterminally positioned on the ovary.

Shortly after publishing the unranked *Hippianae* in 1897, Rydberg (1898) abandoned this name for the equally unranked *Leucophyllae*. Because the type of that name, *Potentilla leucophylla* Torrey, is a later homonym, we have adopted Rydberg's original name. Johnston (1985) included the component species within his section *Subjugae* (Rydberg) B. C. Johnston, which we restrict to *P. subjuga* Rydberg s.l.

New Varietal Names in *Horkelia*

Horkelia californica Chamisso & Schlechtendal var. **elata** (Greene) Ertter & Reveal, comb. nov. Basionym: *Potentilla californica* (Chamisso & Schlechtendal) Greene var. *elata* Greene, Fl. Francisc. 1: 66. 1891, a replacement name for *Potentilla elata* Greene, Pittonia 1: 100. 1887, non *Potentilla elata* Salisbury, Prodr. Stirp. Chap. Allerton: 362. 1796. TYPE: U.S.A. California: Napa Co., shady banks of the upper Napa River above Calistoga, Aug. 1883, *E. L. Greene s.n.* (holotype, NDG).

This name displaces *Horkelia californica* subsp. *dissita* (Crum ex Jepson) Ertter as used by Ertter (1991, 1993). The rank of subspecies had been used to follow Keck (1938) and to avoid concerns about the identity of *Potentilla glandulosa* Lindley var. *incisa* Lindley (Ertter, 1991). We are using the varietal rank in FNA, and can now confirm that variety *incisa* is a member of *Drymocallis* Fourreau ex Rydberg (Ertter, 2007).

Horkelia californica Chamisso & Schlechtendal var. **frondosa** (Greene) Ertter & Reveal, comb. nov. Basionym: *Potentilla frondosa* Greene, Pittonia 1: 300. 1889. *Potentilla californica* Greene var. *frondosa* (Greene) Jepson, Man. Fl. Pl. Calif. 494. 1925. TYPE: U.S.A. California: Contra Costa Co., near Martinez, May 1889, *F. T. Swett s.n.* (lectotype, designated by D. D. Keck (1938: 81), NDG; duplicates, DS, K, NA, OSC, UC).

The rank is altered from subspecies (i.e., subsp. *frondosa* (Greene) Ertter) to variety to correspond with the infraspecific rank used in our treatment of *Horkelia* for *Flora of North America*.

Horkelia clevelandii (Greene) Rydberg var. **brevibracteata** (Wiggins) Ertter & Reveal, comb. et stat. nov. Basionym: *Horkelia brevibracteata* Wiggins, Contr. Dudley Herb. 1: 170, pl. 1. 1933. TYPE: Mexico. Baja California Norte: La Encantada, Sierra San Pedro Mártir, 20 Sep. 1930, *I. L. Wiggins & D. Demaree 4931* (holotype, DS; isotypes, MO, NA, NY, UC, US, UTC).

The variety *brevibracteata* differs from variety *clevelandii* in being a more compact, matted plant with shorter stems (1–2.5(–3) dm vs. 1–4.5 dm in variety *clevelandii*) and basal leaves with 11 to 16 pairs of lateral leaflets instead of merely six to 12 pairs as found in the typical phase. Fully mature lateral leaflets of variety *clevelandii* are generally 8–15 mm in length, whereas those of variety *brevibracteata* vary from 4–8 mm in length. As implied by the epithet *brevibracteata*, the epicalyx bractlets are shorter (1.5–2 mm long) on a deeper hypanthium (2–2.5 mm) compared to variety *clevelandii* (2–3.5 mm and 1–1.5 mm, respectively). In addition, the leaves of variety *brevibracteata* are densely glandular with sessile or even punctate glands, a feature not found in the typical phase. The newly established variety is known only from the Sierra San Pedro Mártir and Sierra Juarez of northern Baja California, Mexico. The variety *clevelandii* occurs in the Peninsular Ranges of southern California in Riverside and San Diego Counties, where it is the host plant of the federally endangered Laguna Mountains skipper (*Pyrgus ruralis lagunae* Scott).

Horkelia cuneata Lindley var. **puberula** (Rydberg) Ertter & Reveal, comb. nov. Basionym: *Horkelia puberula* Rydberg, Bull. Torrey Bot. Club 25: 55. 1898, a replacement name for *Potentilla puberula* Greene, Pittonia 1: 102. 1887, non *Potentilla puberula* Krašan, Oestr. Bot. Zeitschr. 17: 304. 1867. *Potentilla lindleyi* Greene var. *puberula* (Rydberg) Jepson, Man. Fl. Pl. Calif. 495. 1925. TYPE: U.S.A. California: San Bernardino Co., mesas 5 mi. W of San Bernardino, 25 Apr. 1885, *S. B. Parish 279* (holotype, NDG; isotypes, GH, UC, WS).

Rydberg (1898) unknowingly proposed *Horkelia puberula* as a new name for the illegitimate *Potentilla puberula*, which was a later homonym. The rank of this

and the following name is changed from subspecies (e.g., *H. cuneata* subsp. *puberula* (Rydberg) D. D. Keck and subsp. *sericea* (A. Gray) D. D. Keck) to variety, although the circumscription of both remains as defined by Keck (1938) and by Ertter (1993).

Horkelia cuneata Lindley var. **sericea** (A. Gray) Ertter & Reveal, comb. nov. Basionym: *Horkelia californica* var. *sericea* A. Gray, Proc. Amer. Acad. Arts 6: 529. 1865. TYPE: U.S.A. California: Alameda Co., vicinity of Oakland, 1863, *W. Holder 2582* (holotype, GH; isotypes, UC, US, YU).

Horkelia daucifolia (Greene) Rydberg var. **caruifolia** (Rydberg ex Howell) Ertter & Reveal, comb. et stat. nov. Basionym: *Horkelia caruifolia* Rydberg ex Howell, Fl. N.W. Amer. 1: 181. 1898. TYPE: U.S.A. Oregon: Jackson Co., Ashland, 16 July 1887, *T. Howell 685* (holotype, ORE 96564 at OSC).

Horkelia daucifolia var. *caruifolia* is known only from the Rogue River drainage in Jackson County, Oregon. It occurs on non-serpentine soils in grassy openings in mixed oak and conifer woodlands at elevations ranging from 500 to 850 m. It differs from the more southern variety *daucifolia* of the Klamath River drainage in north-central California and adjacent Oregon in having leaflets of its basal leaves either entire or divided into four to 15 segments that are 0.4–1 mm wide. In variety *daucifolia*, similar leaflets are divided into two to six linear to oblanceolate segments that are 1–2(–3) mm wide. Petals are also wider in variety *caruifolia* (4–8 mm) than in variety *daucifolia* (2–4 mm). The typical variety occurs primarily in conifer woodlands on serpentine soils at elevations of 500–1650 m. Based on limited material, Keck (1938) considered *H. caruifolia* to be a synonym of *H. daucifolia*, although earlier, Crum (1934) maintained both species as distinct within *Potentilla*. We do not consider *P. daucifolia* var. *divergens* Crum, established because of its more open inflorescence, to be worthy of recognition based on our examination of more abundant material from the Ashland area (where Thomas Howell obtained the type in 1889) than was available to Crum.

The holotype of *Horkelia caruifolia* is the sheet at ORE annotated by Howell as "type specimen." His collection of the same species obtained the following day is more widely distributed: high hills near Ashland, Rogue River Valley, 17 July 1887, *T. Howell 1129* (DS, MIN, MO, NA, NY[2], PENN, PH, UC US, WTU, YU). Keck (1938) considered both of the Howell collections plus a third collection (Ashland, July 1893, *R. M. Austin 256*, CAS, US) to be cotypes. Rydberg annotated one of the NY sheets of *Howell 1129* as "type" but as he did not name the taxon, Howell's selection must be accepted.

Horkelia daucifolia (Greene) Rydberg var. **indicta** (Jepson) Ertter & Reveal, comb. nov. Basionym: *Potentilla daucifolia* Greene var. *indicta* Jepson, Man. Fl. Pl. Calif. 493. 1925. TYPE: U.S.A. California: Tehama Co., Stiver's Ranch, Crane Creek, 25 Apr. 1889, *W. L. Jepson 100p* (holotype, JEPS).

This phase of the species is similar to *Horkelia daucifolia* var. *caruifolia* in that both have basal leaves with numerous, narrow (0.3–0.8 mm wide) segments. It differs from both variety *caruifolia* and variety *daucifolia* in having longer pedicels on average (5–20 mm vs. 2–10 mm) that have abundant short glands and relatively sparse hairs, whereas pedicels of the other two varieties are more densely puberulent and only obscurely glandular. Jepson's horkelia, as we hereby term this extremely rare variety, is currently known from only two collections from the Sacramento River drainage on the edge of the Sacramento Valley in Tehama and Counties of California.

Horkelia fusca Lindley var. **brownii** (Rydberg) Ertter & Reveal, comb. et stat. nov. Basionym: *Horkelia brownii* Rydberg, N. Amer. Fl. 22: 276. 1908. TYPE: U.S.A. California: Siskiyou Co., south side of Mt. Shasta, 15–31 July 1897, *H. E. Brown 530* (holotype, NY; isotypes, BKL, F, MO, PH, UC, US).

The above name is adopted here to replace the misapplication of *Horkelia fusca* subsp. *pseudocapitata* (Rydberg ex Howell) D. D. Keck, an error originally promulgated by Rydberg (1898) when he took up the just-published *H. pseudocapitata* Rydberg ex Howell. Although Howell (1898) believed he was simply incorporating one of Rydberg's species in his *Flora of Northwest America*, the two authors designated different type specimens and used circumscriptions that excluded the other person's type. Howell's type, so indicated as such in his own hand on the only specimen in his herbarium from the cited locality, is *T. Howell 399* (ORE 96569, now at OSC), collected 12 June 1885 on Buck Mountain, Baker County, Oregon. In contrast, Rydberg considered the type of *H. pseudocapitata* to be a now-lost T. S. Brandegee specimen from Janesville (given by Rydberg as "Tanesville"), Lassen County, California, formerly at CAS (Heller, 1905) and presumably destroyed in the

1906 earthquake. The Brandegee sheet was not seen by Howell and therefore does not qualify as original material, and thus could not be designated a lectotype by Rydberg.

Howell's type specimen from Oregon belongs to a relatively large-petaled (4–6 mm) taxon with glandular leaflet blades that, in our interpretation, ranges throughout the northern Intermountain West from Grant and Klamath Counties, Oregon, eastward to south-central Idaho, with southern extensions into Modoc County, California, and Elko County, Nevada. These plants fall within Keck's (1938) circumscription of *Horkelia fusca* subsp. *capitata* (Lindley) D. D. Keck, but we are restricting variety *capitata* (Lindley) M. Peck to plants occurring farther north in northeastern Oregon, southwestern Washington, and northern Idaho that have narrower, more purple, and more glandular hypanthia. The northern Intermountain entity accordingly takes the name *H. fusca* var. *pseudocapitata* (Rydberg ex Howell) M. Peck, following Howell's original concept.

In contrast, the description and distribution of *Horkelia pseudocapitata* as given by Rydberg and followed by subsequent authors represents a different entity occurring to the south and west of *H. fusca* var. *pseudocapitata* as now circumscribed. This entity, which includes most of the specimens cited by Rydberg, consists of small-petaled (2–4 mm) plants characterized by hirsute to villous stems and hoary, relatively narrow leaflets. Such plants are found primarily on pumice flats and low hills from Mt. Shasta, Siskiyou County, eastward into Lassen, Modoc, and northern Plumas Counties of northern California. The site of Brandegee's lost collection from Janesville is at the southeastern edge of the hoary-leaved entity's range, and a recent collection from the same general locality (*Ertter & Schoolcraft 7312*, UC) falls within the general concept. The type of *H. brownii* Rydberg is fully representative of this entity, so the combination *H. fusca* var. *brownii* is here established to accommodate this taxon to which the epithet *pseudocapitata* has been misapplied.

Horkelia tridentata Torrey var. **flavescens** (Rydberg) Ertter & Reveal, comb. nov. Basionym: *Horkelia flavescens* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 138, t. 75. 1898. *Potentilla tilingii* (Regel) Greene var. *flavescens* (Rydberg) J. T. Howell, Leafl. W. Bot. 4: 176. 1945. TYPE: U.S.A. California: s. loc., 1875, *J. G. Lemmon 90* (holotype, NY; isotypes, BKL, F, MO, NY, UC).

The combination established here maintains a taxon accepted by both Keck (1938) and by Howell (1945). We recognize the name at the rank of variety, not as a subspecies as proposed by Keck, and in *Horkelia* rather than *Potentilla* as suggested by Howell.

New Varieties and Combinations in *Ivesia*

Ivesia argyrocoma (Rydberg) Rydberg var. **moranii** Ertter & Reveal, var. nov. TYPE: Mexico. Baja California Norte: Sierra San Pedro Mártir, 2 mi. W of Vallecitos in granitic soil on gentle slopes associated with *Pinus jeffreyi* at 2250 m, 31°00′N, 115°29′W, 2 June 1968, *R. V. Moran 15078* (holotype, UC; isotypes, CAS, GH, K, MEXU, NY, RSA, SD, US). Figure 1.

A *Ivesia argyrocoma* var. *argyrocoma* plantis brevissimos cum caulibus ad 10 cm longis, stipulis 2–4 mm longis et dense villosis, caulis minute glandulosis et villosis differt.

Etymology. The variety is named for Reid Venable Moran (1916–), one of Baja California's premier botanical collectors. Moran's ivesia is a suitable vernacular name.

Distribution and ecology. *Ivesia argyrocoma* var. *moranii* grows in full sun on granitic soil in dry meadows and along stream banks near conifer forests dominated by *Abies concolor* (Gordon & Glendinning) Hildebrand and *Pinus jeffreyi* Greville & Balfour from 2225 to 2700 m elevation in the Sierra San Pedro Mártir of northern Baja California, Mexico. The variety *argyrocoma* is restricted to gravelly flats ("pebble plains") of Bear Valley in the eastern San Bernardino Mountains of southern California, some 400 km to the north. The typical variety is a rare plant of conservation concern in California. We have not attempted to determine the degree of rarity of variety *moranii* except to note that it has been collected from a relatively small area.

Diagnostic features. Compared to the typical variety, variety *moranii* is a more compact plant with shorter stems (to 10 cm long vs. 15 cm) that are more consistently stipitate-glandular under the loosely villose indumentum. Stipules of the basal leaves are notably larger (2–4 mm vs. 1–2 mm) and more densely villous (vs. glabrous or rarely sparsely villous marginally). The inflorescence in variety *moranii* is a single congested cyme (rather than the more organized one to several capitate clusters of variety *argyrocoma*), with somewhat shorter, oblanceolate to narrowly obovate petals and achenes (2.5–3.5 mm and 1.3–2 mm, respectively, vs. (2.5–)3–4.5 mm and 1.5–2.5 mm). Moran's ivesia is the only member of *Ivesia* sect. *Unguiculatae* in Baja California.

Paratypes. MEXICO. **Baja California Norte:** Sierra San Pedro Mártir, head of Cañada el Copal & S slope of Cerro Venado Blanco, 2500–2700 m, 3 June 1988, *S. Boyd et al. 2316* (RSA); Vallecitos, 2440 m, 24 June 1991, *Clemons &*

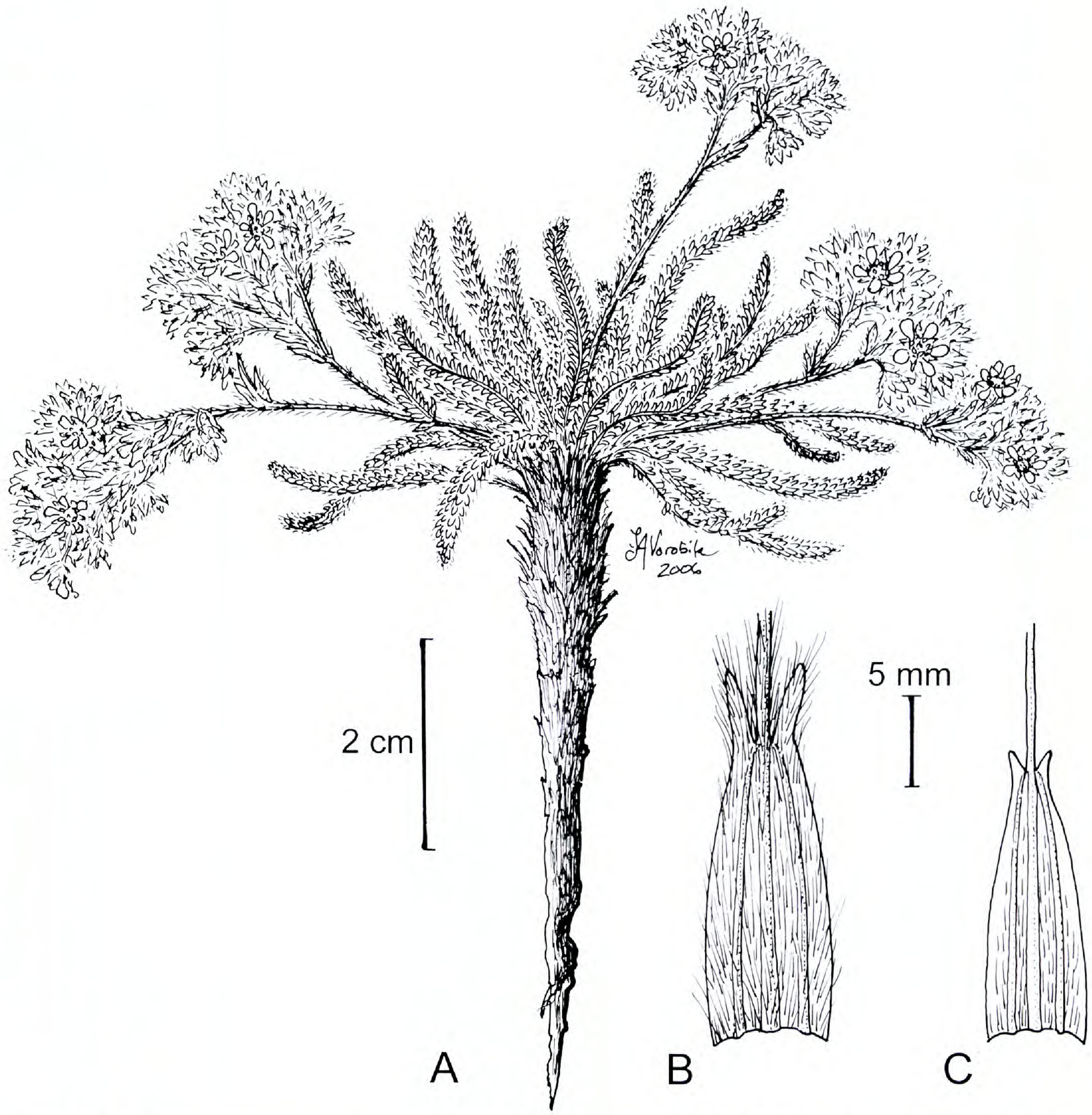

Figure 1. A–B. *Ivesia argyrocoma* var. *moranii* Ertter & Reveal (drawn from the UC holotype *Moran 15078*). —A. Habit. —B. Abaxial view of cauline leaf base, showing elongate stipules and vestiture. —C. *Ivesia argyrocoma* var. *argyrocoma* (Rydberg) Rydberg (drawn from *D. Wm. Taylor 10289*, California, San Bernardino Co., Bear Valley Region, 10 May 1989, *D. W. Taylor 10289*, UC). Abaxial view of cauline leaf base, at same scale as B.

Brey 2317 (SD); Yerba Buena, 2400 m, 4 July 1971, *R. V. Moran 18465* (SD); 5 mi. S of Vallecitos on trail to La Grulla, 2225 m, 3 July 1972, *R. V. Moran 19183* (MEXU, SD); meadow W of Los Llanitos, 2350 m, 2 July 1973, *R. V. Moran 21080* (SD); E end of Vallecitos Meadow, 2600 m, 30 May 1976, *R. V. Moran 23306* (RSA, SD, UC); upper San Juan Creek, 7200–7700 ft., 7 June 1962, *R. G. Olmstead 4587* (RSA); 2 mi. E of Prado del Corona, 8200 ft., 9 June 1962, *R. G. Olmstead 4721* (RSA); 1.7 mi. N of turn to La Tasajera & 2.2 mi. SE of Observatory Rd., Vallecitos area, 2380 m, 25 June 1996, *Rebman & Sosa 3251* (SD); S of Vallecitos near Cerro la Botella Azul, 2590 m, 28 June 1998, *Rebman & Russell 5405* (SD); 2.5 air km W of observatory, 2430 m, 17 June 1988, *A. C. Sanders et al. 7948* (RSA); Vallecitos, 2430 m, 18 June 1985, *R. F. Thorne et al. 60843* (RSA, UC); Vallecitos, 2430 m, 7 May 1986, *R. F. Thorne et al. 61954* (MEXU, RSA, UC); Vallecitos Meadow, 2500 m, 18 June 1971, *I. W. Wiggins 21460* (DS, OSC).

Ivesia gordonii (Hooker) Torrey & A. Gray in J. S. Newberry, Rep. Explor. Railroad Pacific 6(3): 72. 1858 (as *gordoni*).

Ivesia gordonii is the most widespread species of *Ivesia*, occurring from Washington to Montana, south to central California and Colorado and encompassing a great deal of variation that does not parse readily into cleanly circumscribed infraspecific units. Holm-

gren (1997) noted three phases as occurring in the Intermountain West, which he informally referred to and illustrated as gordonii, tenuicaulis, and wasatchensis. Holmgren and Ertter had discussed describing the latter two variants jointly, but the intended follow-up studies were not completed before Holmgren moved on to other volumes of *Intermountain Flora*. Our present survey of several hundred specimens from throughout the species' range indicates additional and more complex variation, occurring as a continuum that can be variously fragmented depending upon the features one prefers to stress (Ertter, 1997). For the present, we have chosen to divide this variation among four varieties that have a biogeographic underpinning, distinguished as in the following key. It is likely that additional entities can be recognized, pending additional work to account properly for the variation within *I. gordonii*.

KEY TO THE VARIETIES OF *IVESIA GORDONII*

1a. Lateral leaflet blades of basal leaves 7–17 mm long, usually glabrous or nearly so; flowering stems erect or nearly so, 1.3–4 dm long, minutely glandular, often glandular-pubescent, infrequently sparsely villous; inflorescence typically branched with multiple heads. . . . . *I. gordonii* var. *wasatchensis*

1b. Lateral leaflet blades of basal leaves 2–7 mm long, hairy or glabrous except for hairy margins; flowering stems prostrate, ascending to spreading or erect, 0.4–2 dm long, minutely glandular and glandular-puberulent or -pubescent, occasionally hirsute or villous, sometimes rather densely so; inflorescence typically unbranched with solitary heads, sometimes more loosely cymose.

2a. Flowering stems prostrate to spreading or ascending, rarely erect, often reddish, minutely glandular or variously glandular-puberulent to -pubescent; leaves usually glabrous except for scattered marginal hairs; northeastern Nevada, southern Idaho, eastern Oregon, and northeastern California. . . . . *I. gordonii* var. *ursinorum*

2b. Flowering stems ascending to erect, usually greenish, villous or hirsute to villous and variously glandular-puberulent to -pubescent; leaves usually hairy or at least somewhat densely so marginally; northern Oregon and southern Washington eastward through northern Idaho to Montana, south into western Colorado, Utah, and California.

3a. Stem usually villous or hirsute to villous and glandular-pubescent; western Montana south through southeastern Idaho, Wyoming to Utah and Colorado . . . . . *I. gordonii* var. *gordonii*

3b. Stems variously glandular-puberulent or -pubescent, usually sparsely villous; western Oregon and Washington through Idaho to extreme western Montana, and in northern California. . . . . *I. gordonii* var. *alpicola*

Ivesia gordonii (Hooker) Torrey & A. Gray var. **gordonii.** Basionym: *Horkelia gordonii* Hooker (as *gordoni*), Hooker's J. Bot. Kew Gard. Misc. 6: 341, pl. 12. 1853. *Potentilla gordonii* (Hooker) Greene (as *gordoni*), Pittonia 1: 106. 1887. TYPE: U.S.A. [Wyoming:] Upper Platte, [1843], *A. Gordon s.n.* (holotype, K).

As defined by us, *Ivesia gordonii* var. *gordonii* is an erect herbaceous perennial with either villous stems, or stems that are both hirsute to villous and variously glandular-puberulent or -pubescent. Its leaves are usually densely hirsute with leaflets usually 2–7 mm in length. The inflorescence of variety *gordonii* is nearly always simply capitate. This phase of the species occurs from southwestern Montana south through western Wyoming to southern Colorado. It is also found in both the Uintah and Wasatch Mountains, where it can be difficult to distinguish consistently from variety *wasatchensis*.

Gordon gathered the type on the "Upper Platte" while traveling with Sir William Drummond Stewart in 1843. This suggests the type was found along the Sweetwater River near the South Pass area of Fremont County, Wyoming. The type in the Hooker Herbarium at the Royal Botanic Garden (K) is most similar to plants found today west of the Pass in Sweetwater County, Wyoming. Stewart and his party were in that area in late July and early August of 1843, and given the condition of the plant, it seems likely that this was when the specimen was gathered.

Ivesia gordonii (Hooker) Torrey & A. Gray var. **alpicola** (Rydberg ex Howell) Ertter & Reveal, comb. nov. Basionym: *Horkelia gordonii* var. *alpicola* Rydberg ex Howell, Fl. N.W. Amer. 1: 182. 1898. TYPE: U.S.A. Washington: dry rocky ridges, alpine heights, Mt. Adams, Washington, 9 Aug. 1882, *T. Howell & L. F. Henderson s.n.* (lectotype, designated here, ORE 46734, now at OSC).

As here circumscribed, *Ivesia gordonii* var. *alpicola* occurs in a great arc from the northern coastal ranges and Sierra Nevada of California sporadically northward into the Cascade Range of northwestern Oregon and southern Washington, then eastward to the Blue and Wallowa Mountains. From there, the variety reappears in the mountains of central Idaho and in the Bitterroot Mountains of western Montana. A disjunct population occurs in the Owyhee Mountains in southwestern Idaho.

The protologue of *Ivesia gordonii* var. *alpicola* placed the new variety on Mount Adams, Washington, without citing any specimens or collectors. Love

(2001) indicated that Howell and Louis F. Henderson were collecting together on Mount Adams in 1882 when they encountered Wilhelm N. Suksdorf. All three made collections of this *Ivesia*, dated either 9 or 10 August, though it is possible that all of the material was gathered once at a single location. Our selection of the lectotype is made on the basis that it conforms to Howell's original description, is from the Howell herbarium, and names both Howell and Henderson as collectors. The other syntypes of variety *alpicola* gathered on Mount Adams in 1882 are *L. F. Henderson 275*, 9 Aug. 1882 (MO, ORE); *L. F. Henderson s.n.*, 10 Aug. 1882 (WS); *T. Howell s.n.*, 10 Aug. 1882 (MO, US); *W. N. Suksdorf s.n.*, 9 Aug. 1882 (PH, WS).

Ivesia gordonii (Hooker) Torrey & A. Gray var. **ursinorum** (Jepson) Ertter & Reveal, comb. nov. Basionym: *Potentilla gordonii* (Hooker) Greene var. *ursinorum* Jepson, Man. Fl. Pl. Calif.: 492. 1925. TYPE: U.S.A. California: Bear Creek, Trinity Mtns., 12 Aug. 1911, *A. M. Alexander & L. Kellogg 313* (holotype, JEPS; isotype, UC).

See Holmgren (1997: 117) for figure.

Ivesia gordonii var. *ursinorum* encompasses Holmgren's (1997) "tenuicaulis phase," which he considered to occur only in the Jarbidge and Independence Mountains of Elko County, Nevada, the Steens Mountains in Harney County, and atop Baldy Mountain in Grant County, Oregon. Our expanded circumscription encompasses additional populations in the mountains of central Idaho, where the variety *ursinorum* is replaced abruptly by variety *alpicola* to the north, and in the Warner Mountains of Modoc County, California, and Lake County, Oregon. The variety is then encountered westward on Scott Mountain and Mount Eddy in Siskiyou and Trinity Counties, where the type of variety *ursinorum* was gathered. Populations also occur in the Sweetwater Mountains and adjacent Sierra Nevada near Sonora Pass in Alpine and Tuolumne Counties; these plants resemble those found in central Idaho, being less sprawling than those of Nevada or Oregon.

As now defined, variety *ursinorum* typically is a low-spreading plant with glandular-pubescent and minutely glandular, reddish, wiry stems. *Ivesia gordonii* var. *alpicola* usually is a larger, more robust and erect plant with its stems variously glandular and occasionally sparsely villous. The two varieties have overlapping ranges (in Idaho mainly), but for the most part the erect habit and compact leaves of variety *alpicola* distinguish it from the sprawling habit and more open leaves of variety *ursinorum*, with the latter also having more consistently reddish stems.

Adoption of the name variety *ursinorum* for Holmgren's tenuicaulis phase is done with reluctance, as the type of variety *ursinorum* is from the least distinctive portion of the taxon's range. We would have preferred to typify the taxon on the Nevada phase, which is clearly distinct. This distinctiveness was initially appreciated by Bassett Maguire and Arthur H. Holmgren, who used the provisional epithets "tenuicaulis" and "aranea" on their collection *22342* (NY, RSA, UC, UTC) from Elko County, Nevada.

Of the two fragmentary plants on *Alexander & Kellogg 313* in the Jepson Herbarium (JEPS 2809), one was clearly removed from the corresponding University Herbarium sheet (UC 195238), leaving behind most of the leaves and inflorescences of that removed fragment. According to herbarium lore, Jepson believed he had the right to help himself to portions of any UC collection, and this is evidently the case here. The UC sheet is the original (and by far the better) sheet, but the JEPS sheet must be accepted as holotype since it is in Jepson's personal collection.

Ivesia gordonii (Hooker) Torrey & A. Gray var. **wasatchensis** N. H. Holmgren ex Ertter & Reveal, var. nov. TYPE: U.S.A. Utah: Salt Lake Co., Wasatch Range, btw. Secret Lake & Albion Basin Campground, SE of Alta, T3S, R3E, sect. 9, 2900 m, 14 Aug. 1983, *B. Ertter 5101* (holotype, UC; isotypes, BRY, MO, NY, RSA, TEX, US, UTC).

Caules erectis, viridis; lateralis foliolorum 7–17 mm longis; antheras flavis; inflorescentiis plerumque leniter ramosis.

See Holmgren (1997: 117) for figure.

Etymology. The name alludes to the Wasatch Mountains of southeastern Idaho and Utah.

Distribution and ecology. Ivesia gordonii var. *wasatchensis* is widely scattered in disjunct, montane populations from 2100 to 2750 m in eastern Idaho, southwestern Montana, and western Wyoming south into central Utah.

Relationships. Ivesia gordonii var. *wasatchensis* is broadly defined by us compared to how it was outlined by Holmgren (1997). The leaves are generally glabrous with only sparsely hirsute or villous margins along the narrow leaflet segments that are themselves 7–17 mm long. The stems of variety *wasatchensis* are minutely glandular (sometimes glandular-puberulent) with some villous hairs, and the inflorescences are usually branched rather than simply capitate. Plants that are densely villous with short, hairy leaflet segments (2–7 mm long) and simple heads are

assigned to variety *gordonii*. Some plants of variety *gordonii* can be as tall (0.7–2(2.5) dm) as typical variety *wasatchensis* (1–4 dm), but on the average, those of the former are shorter. The existence of no clear distinction in the continuum of these features means that some collections will be frustrating to place. Only the most clearly representative specimens of variety *wasatchensis* are cited below.

Independently, Holmgren and the senior author arrived at the conclusion that this taxon was worthy of recognition. Inasmuch as Holmgren coined the name, it is retained here with his name in association, although we had alternatively considered naming it in his honor.

Representative specimens. U.S.A. **Idaho:** Bannock Co., top of Scout Mtn., *Cronquist 309-36* (UTC); Bear Lake Co., Whiskey Flat, along Little Beaver Creek, *A. H. Holmgren & Albee 16523* (RM, UTC); Caribou Co., S of Diamond Flat, *Shultz & Shultz 2717* (RM, UTC); Franklin Co., Bear River Range, upper Franklin Basin, *Ertter & Grimes 2486* (MIN, NY, UTC); Fremont Co., E of Mt. Jefferson, SW of Henry Lake, *Cronquist 1923* (UTC). **Montana:** Beaverhead Co., Odell Creek, *D. Nelson SR-6* (USFS); Custer Co., near Ekalaka, 1941, *Seidensticker s.n.* (UTC); Granite Co., Flint Creek, near Drummond, *Burdick & Mueller 8* (GH, MIN, RM); Madison Co., Lazyman Hill, Gravelly Range, *C. L. Hitchcock 16862* (GH, RSA, UTC, WTU); Park Co., btw. Suksdorf Gulch & Jackrabbit Gulch, 9 mi. NW of Wilsall, *Suksdorf 309* (WSC, WTU). **Utah:** Cache Co., Tony Grove Lake, *Thorne & Thorne 2139* (BRY, RM); Davis Co., Bountiful Peak, *Cottam et al. 15005* (RSA, UT); Duchesne Co., Uinta Mtns., head of Blind Creek, *Harrison & Nisson 8813* (BRY, UTC); Millard Co., Canyon Mtns., 7 mi. NW of Scipio, *Goodrich 17236* (BRY, RM, UTC); Salt Lake Co., Wasatch Mtns., Alta, Aug. 1883, *M. E. Jones s.n.* (BKL, ORE, POM, RM); Sanpete Co., Wasatch Plateau, head of White Ledge Fork, *M. E. Lewis 5624* (UTC); Summit Co., Uinta Mtns., Bald Mtn. Pass, *S. L. Welsh & G. Moore 6662* (BRY, ISC); Utah Co., Provo Peak, *Larsen 6789* (BRY, MIN); Wasatch Co., near Cold Spring, 11 Aug. 1972, *Goodrich s.n.* (UTC). **Wyoming:** Fremont Co., Owl Creek Range, Bird's Eye Pass, *Porter & Porter 8634* (RM); Lincoln Co., Red Mtn., N of Smoot, *Payson & Armstrong 3640* (GH, ISC, NY, POM, RM, US); Park Co., Yellowstone N.P., Yellowstone Lake, *A. Nelson & E. Nelson 6338* (GH, ISC, MIN, MO, NY, RM, US); Teton Co., Grand Teton N.P., Poverty Flat, *R. J. Shaw 1328* (RSA).

Ivesia lycopodioides A. Gray var. **megalopetala** (Rydberg) Ertter & Reveal, comb. nov. Basionym: *Horkelia gordonii* Hooker var. *megalopetala* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 152. 1898. TYPE: U.S.A. California: Mt. Dana, [1866], *H. N. Bolander s.n.* (holotype, CAS).

This and the following are recognized at the rank of variety so as to render consistency of rank in our treatment for *Flora of North America*.

Ivesia lycopodioides A. Gray var. **scandularis** (Rydberg) Ertter & Reveal, comb. nov. Basionym: *Horkelia scandularis* Rydberg, Mem. Dept. Bot. Columbia Coll. 2: 150. 1898. *Potentilla gordonii* (Hooker) Greene var. *scandularis* (Rydberg) Jepson, Man. Fl. Pl. Calif. 492. 1925. *Potentilla lycopodioides* (A. Gray) Baillon ex J. T. Howell var. *scandularis* (Rydberg) J. T. Howell, Leafl. W. Bot. 4: 176. 1945. TYPE: U.S.A. California: Mono Co., White Mtns., 18 Aug. 1888, *W. H. Shockley 572* (holotype, CAS; isotypes, GH, JEPS, UC).

Rydberg annotated the CAS sheet "type," whereas on the GH sheet he wrote "Not *I. pygmaea*, an undescribed species." Accordingly, we accept the CAS specimen as the holotype rather than the GH sheet as stated by Keck (1938).

Acknowledgments. Foremost, we wish to acknowledge the curatorial staff at the multiple herbaria who processed loans used in this study, tracked down additional information upon request, provided hospitality during visits, and remained patient with the length of time the specimens have been retained by the senior author: ARIZ, ASC, ASU, BKL, BM, BRIT/SMU, BRY, CAS/DS, CIC, COLO, DAV, F, GH, HSC, ID, ISC, K, MEXU, MICH, MIN, MO, NA, NDG, NEB, NMC, NY, ORE, OSC, PH, PR, RENO, RM, RSA/POM, SBBG, SD, SRP, TEX, UC/JEPS, UNM, US, UTC, WIS, WS, WTU, and YU. We are indebted to the staff of the University of California Botanical Garden for their loving care of living collections maintained over the course of this study. Kanchi Gandhi (GH) deserves special recognition for helping with a steady stream of nomenclatural tangles, and Linda Vorobik for her prompt illustration of *Ivesia argyrocoma* var. *moranii*. Thanks, too, go to our reviewers. Mini-grants from the Lawrence R. Heckard Endowment Fund of the Jepson Herbarium and from the Flora of North America Committee are gratefully acknowledged.

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Dos Especies Nuevas de *Weinmannia* (Cunoniaceae) de los Bosques Montanos en La Paz, Bolivia

Alfredo F. Fuentes

Herbario Nacional de Bolivia, Correo Central Cajón Postal 10077, La Paz, Bolivia; Missouri Botanical Garden, St. Louis, Missouri, 63166-0299, U.S.A. alfrefuentes@gmail.com

Zachary S. Rogers

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri, 63116-0299, U.S.A. zachary.rogers@mobot.org

Resumen. La investigación reciente de colecciones del género *Weinmannia* L. (Cunoniaceae) en la región de los Yungas en La Paz, Bolivia, revelaron dos especies nuevas endémicas a la zona, que aquí nombramos y describimos como *W. davidsonii* A. Fuentes & Z. S. Rogers y *W. yungasensis* A. Fuentes & Z. S. Rogers. *Weinmannia davidsonii* es similar a *W. bangii* Rusby, y se diferencia por el ovario tomentoso (vs. glabro) y por la mayor cantidad de pubescencia en el envés de las hojas. *Weinmannia yungasensis* es próxima a *W. dryadifolia* Moricand ex Seringe, diferenciándose por las hojas hasta 5-folioladas (vs. hasta 3-folioladas), las hojas simples de mayor tamaño (0.9–3 × 0.8–2.5 cm vs. 1–2 × 0.6–1.2 cm), las estípulas glabras (vs. pubescentes) y por las inflorescencias mas largas (2–)3.5–5.5 (vs. 1–3(–3.5)) cm, que además son laxas (vs. congestas). Ambas especies pertenecen a la sección *Weinmannia* L.

Abstract. A recent investigation of *Weinmannia* L. (Cunoniaceae) material collected from the Yungas region of La Paz, Bolivia, has uncovered two new species, *W. davidsonii* A. Fuentes & Z. S. Rogers and *W. yungasensis* A. Fuentes & Z. S. Rogers, both endemic to the area. *Weinmannia davidsonii* is similar to *W. bangii* Rusby but differs most obviously by the tomentose (vs. glabrous) ovary and denser pubescence of the leaves. *Weinmannia yungasensis* is close to *W. dryadifolia* Moricand ex Seringe but is distinguished most notably by the leaves that are up to 5-foliolate (vs. up to 3-foliolate), the larger simple leaves (0.9–3 × 0.8–2.5 cm vs. 1–2 × 0.6–1.2 cm), the glabrous (vs. pubescent) stipules, and the lax (vs. congested) longer inflorescences ((2–)3.5–5.5 cm vs. 1–3(–3.5) cm). Both species belong to section *Weinmannia* L.

Key words: Bolivia, Cunoniaceae, IUCN conservation status, *Weinmannia*, Yungas.

Weinmannia L. (Cunoniaceae) es un género pantropical de árboles y arbustos con alrededor de 150 especies distribuidas a nivel mundial (Bradford, 1998; Harling, 1999). Este género es representativo y abundante en los bosques montanos, generalmente distribuido a 1300–3520 m de elevación en Bolivia. El género se distingue vegetativamente por sus hojas simples o compuestas imparipinnadas con estípulas interpeciolares. Aunque en el neotrópico, *Weinmannia* a sido estudiado en extenso por Bernardi (1961, 1963), en tratamientos florísticos regionales de Venezuela (Bradford & Berry, 1998) y Ecuador (Harling, 1999), y en publicaciones recientes de nuevas especies del Ecuador (Rogers, 2002a, b), Costa Rica y Colombia (Morales, 2005), aún existen problemas de identificación especialmente con material recientemente coleccionado en los Andes. En el neotrópico se encuentran alrededor de 77 especies, de las cuáles 20 han sido registradas en Bolivia (Gutiérrez, 1993). En el listado florístico de la familia (Harling, com. pers.) para su inclusión en el proyecto del *Catálogo de las Plantas Vasculares de Bolivia* se reportan 29 especies, incluyendo una endémica.

Durante la revisión de las colecciones de *Weinmannia* efectuadas por el proyecto *Inventario Florístico de la Región del Madidi* llevado a cabo por el Herbario Nacional de Bolivia (LPB) y el Missouri Botanical Garden (MO), encontramos dos morfoespecies provenientes de bosques montanos de Yungas. Después de una minuciosa y cuidadosa revisión de la literatura relevante y de los tipos y ejemplares de las especies sudamericanas, y especialmente andinas, depositados en varios herbarios importantes (BOLV, GB, LPB, MO, NY, USZ), descubrimos que estas morfoespecies se distinguen de las especies relacionadas por varios caracteres (ver abajo), confirmando que estas variantes morfológicas, de hecho, representan dos nuevas especies de *Weinmannia* en Bolivia. Las dos especies pertenecen a *Weinmannia* sección *Weinmannia* Bernardi, la única presente en el neotrópico (Bradford, 1998). Aquellas incrementan el número de especies de *Weinmannia* en la región de Madidi a 15 (Fuentes, datos inéditos).

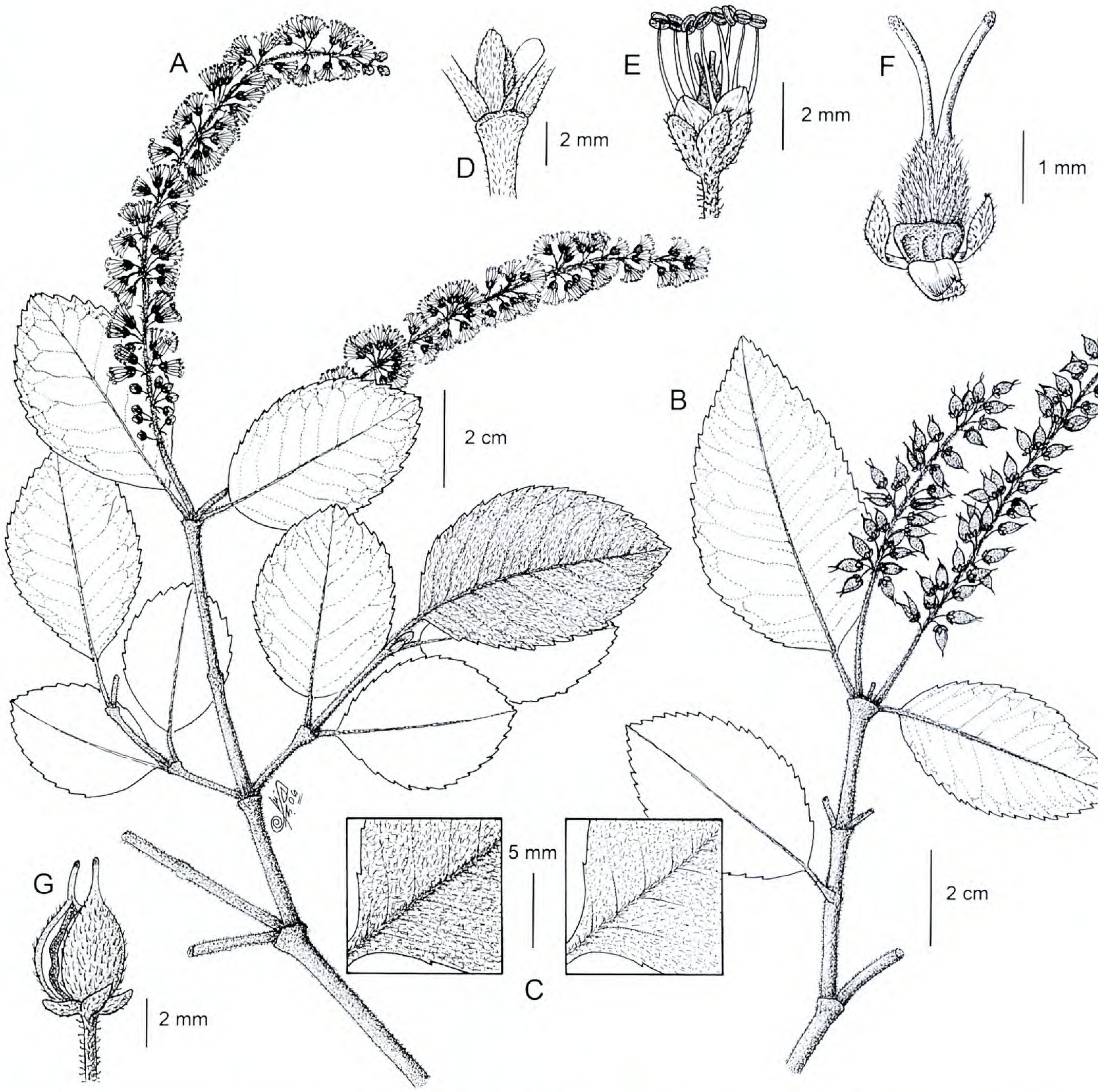

Figura 1. *Weinmannia davidsonii* A. Fuentes & Z. S. Rogers. —A. Rama con inflorescencias. —B. Rama con infrutescencias. —C. Detalle de la hoja, a la izquierda la superficie abaxial y a la derecha la superficie adaxial. —D. Detalle de las estípulas. —E. Flor. —F. Detalle del ovario, nectario floral y sépalos (estambres y pétalos removidos). —G. Cápsula septicida. A, C, E y G dibujados del holótipo (*A. Fuentes et al. 10706*, LPB); B y F de *A. Sanjinés & M. R. Orellana 882* (LPB); D de *M. R. Orellana & N. Quispe 1839* (LPB).

Weinmannia davidsonii A. Fuentes & Z. S. Rogers, sp. nov. TIPO: Bolivia. Dpto. La Paz: Prov. Muñecas, arroyo Carpa entre Camata y Cuibajá, fragmento del bosque montano superior estacional, transicionando a ceja de monte, 3100 m, 15°19′51″S, 68°46′13″W, 17 mayo 2006 [fl, fr], *A. Fuentes, A. Poma & E. Monroy 10706* (holotipo, LPB; isotipos, GB, LPB, MO). Figura 1.

Haec species a *Weinmannia bangii* Rusby foliorum pagina abaxiali indumento densiore vestita, sepalis abaxialiter uniformiter pilosis (vs. apicem versus tantum ciliatis), ovario dense hirsuto (vs. glabro) atque capsula hirsuto-pilosa usque pilosa (vs. glabra) differt.

Arbol o arbolito 2–15 m de alto; entrenudos 0.8–5 cm; ramas pardo amarillentas o pardas cuando jóvenes, planas dorsoventralmente cerca de los nudos cuando jóvenes, después teretes, densamente hirsutas de jóvenes, los tricomas 0.5–1.2 mm; *Hojas* opuestas, decusadas, simples; estípulas caducas, triangulares a triangular-ovadas, 4–7 × 3–5 mm, subcartáceas, glabras adaxialmente, densa a moderadamente pilosas con la edad abaxialmente, la base subcordada, el margen entero, el ápice agudo, obtuso o redondeado; pecíolo 0.3–1.2(–1.5) cm, 0.8–1.2 mm diam., hirsuto, plano adaxialmente, redondeado abaxialmente; lámina elíptica a ovada, raramente oblonga, (1.8–)4.5–7(–7.7) × (1.5–)2.3–4(–4.7) cm, cartácea a subcoriácea, pilosa a glabrescente adaxialmente, hirsuta con textura suave al tacto abaxialmente, el ápice agudo, a veces obtuso o redondeado, la base obtusa o

cortamente atenuada a subcordada, el margen aserrado, usualmente entero hacia la base, aplanado, a veces revoluto hacia la mitad superior, el nervio central sobresaliendo en una hendidura adaxialmente, prominente abaxialmente, los nervios secundarios 8 a 17 pares, aplanados, ligeramente a prominentemente impresos adaxialmente, prominentes abaxialmente. *Inflorescencias* 6–13 × 1.2–1.5 cm, pseudoracemosas, en pares hacia el ápice de las ramas; pedúnculos axilares, 1–2.5 × 0.11–0.15 cm, tetragonales, hirsutos; raquis 5–11 cm, hirsuto; brácteas florales lanceoladas a triangular-ovadas, ca. 1.2 × 0.6 mm, estrigoso-hirsutas, con tricomas largos en el envés, subtendiendo fascículos de 3 ó 4(5) flores. *Flores* bisexuales, 4- ó 5-meras, blancas; pedicelo 2.5–5 mm, ca. 0.25 mm diam., hirsuto-estrigoso; sépalos 4 ó 5, largamente triangulares, 1–1.2 × 0.5–0.7 mm, cartáceos, glabros adaxialmente, en general uniformemente pilosos abaxialmente, el margen claro, membranáceo, el ápice agudo; pétalos 4 ó 5, elípticos, ca. 1.7 × 1.3 mm, membranáceos, glabros o muy laxamente pilosos abaxialmente, el margen entero, el ápice redondeado a agudo, el nervio central más o menos evidente; estambres 8 ó 10, los filamentos 3–3.5 mm, glabros, las anteras reniformes, ca. 0.5 mm; nectario floral cupuliforme, ca. 0.5 mm, 0.8–1 mm diam., con 8 ó 10 surcos en los cuales se apoyan las bases de los filamentos; ovario bilocular, ovoide, ca. 2 × 0.5–1.6 mm (longitud incluyendo los estilos), dorado, densamente hirsuto; estilos 2, 1.2–2 mm, hirsutos hacia la base; estigma clavado. *Infrutescencias* hasta 12 cm, congestas. *Fruto* una cápsula septicida, 2-valvada, anchamente-elíptica a redondeada, 4–6 × 2–3 mm (longitud incluyendo los estilos), rojiza cuando inmadura, pardo oscura cuando madura, hirsuto-pilosa a pilosa, ocasionalmente con una o varias líneas longitudinales aparentes en la superficie externa; estilos persistentes 1–2.2 mm; semillas reniformes, 0.6–1 × 0.4–0.6 mm, pardas, laxamente vilosas sobre el dorso, los tricomas pardo-amarillentos, ca. 1.2 mm.

Distribucion y habitat. De momento conocida solamente en los bosques de los pisos montanos y ceja de monte inferior, en áreas con climas pluviales del departamento de La Paz, Bolivia, entre 2600 y 3501 m en la provincia biogeográfica de los Yungas Peruano-Bolivianos (Navarro, 2002), por lo que probablemente se encuentra en el Perú. Esta nueva especie crece principalmente en bosques primarios pero también en bosques sucesionales secundarios.

Estado de conservación. El área de distribución de *Weinmannia davidsonii* se restringe al departamento de La Paz en un rango altitudinal que paulatinamente está siendo deforestado por los pobladores locales para transformarlo en áreas agrícolas y ganaderas. Esta especie tiene una extensión de presencia de 3037 km^2 y un área de ocupación de 1264 km^2 (utilizando un tamaño de celda de 18 × 18 km). Por las anteriores razones consideramos que esta especie puede ser catalogada como vulnerable considerando los siguientes criterios (IUCN, 2001): VU B1ab+B2ab.

Fenología. *Weinmannia davidsonii* ha sido colecionada con flores en mayo y con frutos entre junio y noviembre.

Discusión. *Weinmannia davidsonii* es similar a *W. bangii* Rusby, endémica a Bolivia (Harling, com. pers.), pero se diferencia en general por la mayor cantidad de indumento distribuido en todos los órganos, especialmente en el envés de las hojas, por los sépalos uniformemente pilosos abaxialmente (vs. sólo ciliados hacia el ápice), el ovario densamente hirsuto (vs. glabro) y los frutos hirsuto-pilosos a pilosos (vs. glabros). A juzgar por las colecciones efectuadas y depositadas en el Herbario Nacional de Bolivia (LPB), *W. davidsonii* se distribuye en los bosques montanos de la mitad norte del dpto. de La Paz, mientras que *W. bangii* se distribuye desde la mitad sur de La Paz hasta los departamentos de Cochabamba y Santa Cruz, teniendo ambas especies un área de sobreposición en el sector de la localidad de Unduavi, La Paz.

Algunos espécimenes de *W. auriculata* D. Don como aquellos referidos anteriormente a *W. caucana* Killip (*Pennell & Killip 8286* y *8306* [tipo], NY) presentan el ovario laxamente piloso pero no densamente hirsuto como en nuestra especie, además sus hojas son glabras. *Weinmannia ilutepuiensis* P. E. Berry & J. Bradford, de los tepuis de Venezuela, es una otra especie de hojas simples que guarda una cierta similitud con *W. davidsonii*, pero aquella presenta un indumento densamente lanoso en las ramas, las hojas, las inflorescencias, el ovario y los frutos.

Etimología. El epíteto rinde homenaje al Dr. Christopher Davidson, quien coleccionó el primer espécimen de esta especie en 1976. El Dr. Davidson y su esposa, Sharon Christoph, son entusiastas botánicos que participan y colaboran en actividades de investigación y conservación emprendidas por el Missouri Botanical Garden y el Herbario Nacional de Bolivia.

Paratipos. BOLIVIA. **Dpto. La Paz:** Prov. Bautista Saavedra, Paján, 2660 m, 25 ago. 2000, *A. Sanjinés & M. R. Orellana 882* (LPB); Prov. Franz Tamayo, Parque Nac. Madidi, entre Keara y Mojos, 3501 m, 24 jun. 2005, *A. Fuentes et al. 8657* (LPB, MO); Parque Nac. Madidi, sect. Quimsa Cruz, entre Calla y Tokoake, 3300 m, 25 jun. 2005, *A. Fuentes, I. Jiménez, R. Hurtado & R. Cuevas 8743* (GB,

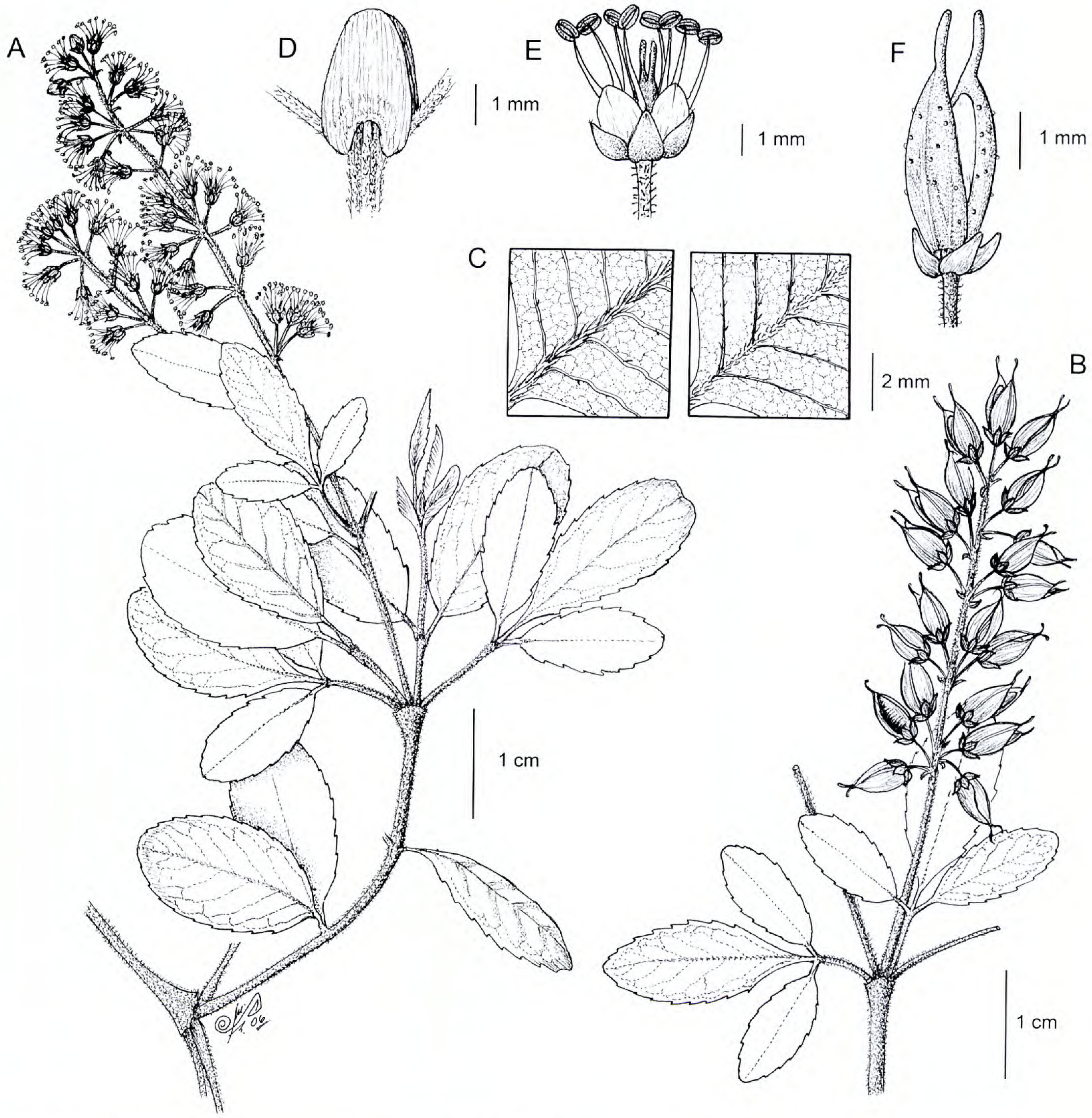

Figura 2. *Weinmannia yungasensis* A. Fuentes & Z. S. Rogers. —A. Rama con inflorescencias. —B. Rama con infrutescencia. —C. Detalle de la hoja, a la izquierda la superficie abaxial y a la derecha la superficie adaxial. —D. Detalle de la estípula. —E. Flor. —F. Cápsula septicida (los nódulos en los frutos son probablemente el resultado de daño por insectos). A, C, D y E dibujados de *S. Beck 17713* (GB, LPB); B y F del holótipo (*A. Fuentes et al. 8724*, LPB).

LPB, MO); camp. Chunkani, 2859 m, 7 nov. 2001, *M. R. Orellana & N. Quispe 1865* (LPB), *1839* (LPB); Prov. Muñecas, Camata, alturas de Quiñuaña, 3.7 km al SW del pueblo de Camata, 2820 m, 15 mayo 2006, *A. Fuentes, A. Poma & E. Monroy 10622* (LPB, MO); Prov. Nor Yungas, 26.4 km SW de Yolosa, tow. Unduavi, ca. 2750 m, 12 nov. 1976, *C. Davidson 4963* (MO, NY).

Weinmannia yungasensis A. Fuentes & Z. S. Rogers, sp. nov. TIPO: Bolivia. Dpto. La Paz: Prov. Franz Tamayo, Parque Nac. Madidi, sect. Quimsa Cruz, entre Calla y Tokoake, bosque de Yungas en ceja de monte inferior pluvial, 3300 m, 14°39′18″S, 68°57′47″W, 25 jun. 2005 [fl, fr], *A. Fuentes, I. Jiménez, R. Hurtado & R. Cuevas 8724* (holotipo, LPB; isotipos, BOLV, GB, LPB, MO, USZ). Figura 2.

Haec species a *Weinmannia dryadifolia* Moricand ex Seringe stipulis glabris (vs. pubescentibus), foliolis usque ad 5 (vs. 3), foliis simplicis majoribus usque ad 3 × 2.5 (vs. 2 × 1.2) cm atque inflorescentia laxa (vs. congesta) longiore usque ad 5.5 (vs. 3.5) cm longa differt.

Arbolito o arbusto 2–9.5(20) m de alto; entrenudos 0.5–3 cm; ramas pardo amarillentas cuando jóvenes, pardo rojizas en vivo, planas dorsoventralmente cerca de los nudos cuando jóvenes, después subcuadrangu-

lares o teretes, densamente hirsutas a hirsuto-vilosas de jóvenes, los tricomas 0.5–1.3 mm. *Hojas* opuestas, decusadas, verde claras a pardo claras cuando secas, simples o 3- ó 5-folioladas; estípulas caducas, anchamente ovadas a oblongas, 3.5–5(–7) × 2.5–3.5(–5.5) mm, subcartáceas, glabras, la base auriculada, el margen entero, el ápice redondeado. *Hojas simples* con pecíolo 1.5–6 mm, hirsuto-piloso, con tricomas hasta ca. 2 mm abaxialmente, plano adaxialmente, triangular en sección transversal, sin alas; lámina anchamente elíptica u ovada a obovada, a veces orbicular, 0.9–3 × 0.8–2.5 cm, coriácea a cartácea, glabra o hirsuto-pilosa con tricomas cortos en el nervio principal adaxialmente y hirsuto-estrigosa con tricomas más largos y ralos hasta ca. 2 mm, en el nervio principal abaxialmente, menos frecuentemente en los nervios secundarios, además con fascículos de tricomas caducos en los senos de los dientes del margen, el ápice obtuso, la base obtusa-decurrente a aguda-decurrente, el margen en su mayor parte aserrado, entero hacia la base, ligeramente revoluto a plano, el nervio central plano a prominente adaxialmente, prominente abaxialmente, los nervios secundarios 5 ó 9 pares, los nervios de orden menor ligeramente prominentes a ligeramente inmersos adaxialmente, prominentes abaxialmente. *Hojas compuestas* con pecíolo 4–15 mm, hirsuto-piloso con tricomas hasta ca. 2 mm abaxialmente, plano adaxialmente, triangular en sección transversal, con o sin alas; raquis 0.4–1.4 cm, con alas revolutas y glabras hasta 4 mm de ancho; folíolos coriáceos a cartáceos, glabros o hirsuto-pilosos con tricomas cortos en el nervio principal adaxialmente y hirsuto-estrigosos con tricomas más largos y ralos hasta ca. 2 mm en el nervio principal abaxialmente, menos frecuentemente en los nervios secundarios, además con fascículos de tricomas caducos en los senos de los dientes del margen, el margen en su mayor parte aserrado, entero hacia la base, ligeramente revoluto a plano, el nervio central plano a prominente adaxialmente, prominente abaxialmente, nervios de orden menor ligeramente prominentes a ligeramente inmersos adaxialmente, prominentes abaxialmente; folíolo terminale elíptico u obovado a ovado, 1–2.5(–3.7) × 0.5–1.2(–2) cm, más largo que los laterales, la base decurrente, el ápice obtuso, redondeado o agudo; folíolos laterales elípticos a obovados, 0.8–1.8(–2.9) × 0.3–0.9(–1.6) cm, la base decurrente, asimétrica, el ápice obtuso a agudo. *Inflorescencias* (2–)3.5–5.5 × 0.7–1 cm, pseudoracemosas, en pares hacia el ápice de las ramas, laxas; pedúnculos axilares, 1–1.5 × ca. 0.1 cm, tetragonales, hirsuto-vilosos a hirsutos; raquis 2–4.3 cm, hirsuto-viloso; brácteas florales oblongas a ovadas, 1–1.5 × 0.5–1 mm, glabras, subtendiendo fascículos de (2)3 ó 4 flores. *Flores* bisexuales, 4- ó 5-meras, rosadas o blancas en fresco; pedicelo 1.5–3 mm, 0.2–0.3 mm diam., estrigoso-hirsuto; sépalos 4 ó 5, triangulares, 1.2–1.5 × 0.8–1.2 mm, cartáceos, casi glabros, el margen entero, el ápice agudo a obtuso, ciliado; pétalos 4 ó 5, elípticos, 1.6–2 × 1.2–1.5 mm, membranáceos, glabros, el margen entero, el ápice obtuso o redondeado, el nervio central evidente; estambres 8 ó 10, los filamentos 2.5–4 mm, glabros, las anteras reniformes, ca. 0.5 mm; nectario floral cupuliforme, ca. 0.5–0.7 mm, 1.3–1.5 mm diam., con 8 ó 10 surcos en los cuales se apoyan las bases de los filamentos; ovario bilocular, ovoide, 1–2.4 × 0.5–1 mm (longitud incluyendo los estilos), pardo-grisáceo en seco, glabro; estilos 2, 1–1.5 mm, glabros, estigma clavado. *Infrutescencias* hasta 7 cm, laxas. *Fruto* una cápsula septicida, 2-valvada, ovada o elíptica, 5–7 × 2–2.5 mm (longitud incluyendo los estilos), rojiza cuando inmadura, pardo oscura cuando madura, glabra, con una o varias líneas longitudinales en la superficie externa; estilos persistentes 2–3 mm; semillas reniformes, 1.2 × 0.5–0.8 mm, pardas, laxamente vilosas sobre el dorso, los tricomas pardo-amarillentos, ca. 1 mm.

Distribucion y habitat. Esta especie se conoce hasta el momento en los bosques de ceja de monte inferior y bosques montanos pluviales del departamento de La Paz, Bolivia, generalmente entre 2700 y 3250 m (sin embargo los datos de colección en el espécimen *Antezana et al. 1622* [BOLV, LPB] reportan una elevación mucho más baja de 1740 m en comparación con las otras colecciones) en la provincia biogeográfica de los Yungas Peruano-Bolivianos (Navarro, 2002), y probablemente también en áreas de bosques montanos adyacentes del Perú. *Weinmannia yungasensis* crece principalmente en bosques de filos y laderas frecuentemente expuestos a nieblas y vientos.

Estado de conservación. Esta especie tiene una extensión de presencia de 577 km^2 y un área de ocupación de 957 km^2 (empleando un tamaño de celda de 18 × 18 km). El área de distribución de esta especie se encuentra en la actualidad sometida a procesos de conversión de los bosques a tierras para agricultura, por lo que *Weinmannia yungasensis* puede ser catalogada preliminarmente como vulnerable considerando los siguientes criterios (IUCN, 2001): VU B1ab+B2ab.

Fenología. Esta especie se ha encontrado con flores entre marzo y agosto y con frutos entre junio y agosto.

Discusión. Weinmannia yungasensis presenta mayor similitud con *W. dryadifolia* Moricand ex Seringe pero se diferencia por las estípulas glabras (vs. pubescentes), las hojas hasta 5-folioladas (vs.

hasta 3-folioladas), las hojas simples mayores 0.9–3 × 0.8–2.5 cm (vs. 1–2 × 0.6–1.2 cm), las inflorescencias más largas (2–)3.5–5.5 cm (vs. 1–3(–3.5) cm) y laxas (vs. congestas). *Weinmannia stenocarpa* Killip & A. C. Smith presenta inflorescencias con una longitud similar a nuestra especie pero sus hojas son simples y auriculadas a iregularmente lobadas (vs. simples a regularmente 3-(ó 5–) folioladas). El hábito de la nueva especie es característicamente el de un árbol pequeño de hasta 9.5 m de alto. Sin embargo, los datos de colección de *Antezana et al. 1617* y *1622* (BOLV, LPB) reportan árboles substancialmente más altos (15 y 20 m de alto, respectivamente).

Etimología. El epíteto hace alusión a la región de los bosques montanos del departamento de La Paz, localmente conocidos como "Yungas" (Ibisch et al., 2003).

Paratipos. BOLIVIA. **Dpto. La Paz:** Prov. Franz Tamayo, Parque Nac. Madidi, abajo de Tres Cruces, 3250 m, 8 mayo 2003, *I. Jiménez 1899* (LPB); Campamento Chuncani, 2859 m, 7 nov. 2001, *M. R. Orellana & N. Quispe 1825* (LPB); Prov. Nor Yungas, de la cumbre bajando 30 km hacia Chuspipata, 2980 m, 21 jul. 1990, *S. Beck 17713* (GB, LPB); La Paz-Santa Bárbara, pasando Cotapata, 3000 m, 5 ago. 2001, *S. Beck & S. Renner 25959* (LPB); entre Chuspipata y San Rafael, 2850 m, 8 mar. 1996, *S. Beck 22665* (GB, LPB); Hornuni Alto, 3140 m, 7 ago. 2003, *S. Beck, P. Duchen, A. Palabral, V. Paredes, N. Thompson & M. Villca 28858* (GB, LPB); Cerro Hornuni, por el sendero de la mina al segundo refugio, 2980 m, 22 oct. 2000, *I. Jiménez & J. Quisbert 41* (LPB), *361* (LPB); Cotapata, Estación Biológica de Tunquini, serranía Hornuni, 2693 m, 29 ago. 2002, *R. de Michel, M. Sauvain, A. Apaza, E. Mayta & D. Pérez 404* (LPB); Prov. Sud Yungas, camino nuevo a Cotapata, 1740 m, 25 jul. 2001, *C. Antezana, G. Navarro, W. Ferreira & E. Maradiegue 1622* (BOLV, LPB); Camino nuevo a Cotapata, 2760 m, 25 jul. 2001, *C. Antezana, G. Navarro, W. Ferreira & E. Maradiegue 1617* (BOLV, LPB).

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A New Combination in *Heterophyllium* (Bryopsida, Sematophyllaceae), with a Key to the Himalayan Species

Yu Jia

Institute of Botany, Chinese Academy of Sciences, Beijing, 100093, People's Republic of China.
yjia@ibcas.ac.cn

Si He and Marshall R. Crosby

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
si.he@mobot.org; marshall.crosby@mobot.org

Abstract. An evaluation of Asian *Brotherella* Loeske ex M. Fleischer reveals that a new combination in the genus *Heterophyllium* (Schimper) Kindberg is necessary to replace *B. amblystega* (Mitten) Brotherus for its noticeably dimorphic stem and branch leaves, strongly serrate leaf apices, differentiated alar cells in an excavate group, erect and symmetric capsules, and strongly papillose spores. *Heterophyllium amblystegum* (Mitten) Y. Jia, S. He & Crosby is here validated and lectotypified along with a full description and a key to the Himalayan species of *Heterophyllium*.

Key words: *Brotherella*, Bryopsida, *Heterophyllium*, Himalayas, *Pylaisiadelpha*, Sematophyllaceae.

The circumscription of the genus *Brotherella* Loeske ex M. Fleischer has been in revision since Loeske (1910) first proposed it invalidly, on the basis of two infrageneric groups of *Stereodon* Mitten in Brotherus (1908): subgenus *Heterophyllium* (Schimper) Lindberg and subgenus *Pseudo-Rhaphidostegium* Brotherus. While validating the genus, Fleischer (1914) modified its delimitation by excluding those species once placed in the subgenus *Heterophyllium* (Brotherus, 1908). Brotherus (1925) basically followed the concept of Fleischer (1914) in recognizing the generic status of *Brotherella*. Since then, *Brotherella* has been widely accepted until Buck (1984) recently proposed the replacement of *Brotherella* by *Pylaisiadelpha* Cardot. However, Ando et al. (1989) argued that the two genera are distinct from each other and maintained the same generic concept of Fleischer (1914) on *Brotherella*. Most recently, Buck and Goffinet (2000) yet again recognized *Brotherella* and *Pylaisiadelpha* as two independent genera, which also represents the opinion of the present paper.

A study of Asian *Brotherella* reveals that one of its species, *B. amblystega* (Mitten) Brotherus has been misplaced in its current genus. Our examination of the type specimens of this species uncovers several critical features that do not fit into the circumscriptions of *Brotherella* and *Pylaisiadelpha*, but are more characteristic of *Heterophyllium* (Schimper) Kindberg (see Table 1). The distinct features are the regularly pinnately branched stems, the dimorphic stem and branch leaves with long-acuminate and strongly serrate apices; the differentiated alar region consisting of enlarged, reddish brown, and thick-walled cells forming an excavate group; the erect and symmetric capsules; the perfect peristome with a high basal membrane and two cilia; and the distinctly papillose spores. Buck (1998) rightly stated that the genus *Heterophyllium* was readily recognized by the long-acuminate leaves with gradually tapered, strongly serrate acumina and well-differentiated alar cells in an excavate group. Based on the morphological features of *B. amblystega*, the following new combination is necessary. Although *Index Muscorum* (Wijk et al., 1962, 1969) attributes the combination *H. amblystegum* to "Musci Fl. Buitenzog 4: 1174, 1923," Fleischer (1923) provided no direct or indirect reference to any basionym there, citing only "H[eterophyllium] amblystegum [sic]," i.e., there is not any indication of a basionym author. In page 1697 of the index, Fleischer (1923) cited only H. "amblystegum (Wils.) Flsch." Therefore, we are treating these as invalid. It may be noted that, of the slightly more than 400 new combinations attributed to Fleischer's *Musci der Flora von Buitenzorg* in the *Index Muscorum*, many were proposed in exactly the same way, i.e., not even indirect indication of basionyms was given. There are several instances in *Glossadelphus* on page 1352 (Fleischer, 1923). These should be studied and validated on a case-by-case, as-needed basis.

Heterophyllium amblystegum (Mitten) Y. Jia, S. He & Crosby, comb. nov. Basionym: *Stereodon amblystegus* Mitten, J. Proc. Linn. Soc., Bot., Suppl. 2: 97. 1859. *Brotherella amblystega*

Table 1. Character comparisons of *Brotherella*, *Pylaisiadelpha*, and *Heterophyllium*.

	Brotherella	*Pylaisiadelpha*	*Heterophyllium*
Plants	± complanate	usually not complanate	not complanate
Stems	irregularly branched or rarely subpinnately branched	irregularly branched	subpinnately to pinnately branched
Leaves	stem and branch leaves not clearly differentiated; upper margins serrulate to serrate, or nearly entire	stem and branch leaves not clearly differentiated; upper margins denticulate or nearly entire	stem and branch leaves differentiated; upper margins strongly serrate
Alar cells	usually enlarged and inflated, consisting of a row of rather thin-walled cells at base	not conspicuously enlarged or inflated	enlarged, subquadrate, thick-walled, forming an excavate group
Capsules	strongly inclined to nearly horizontal, ± asymmetric	erect to slightly inclined, symmetric	erect to somewhat inclined, symmetric or asymmetric;
Peristome	peristome perfect; basal membrane often higher than 1/3 the height of the teeth; cilia poorly developed or 1 to 2, delicate	peristome rather imperfect, basal membrane often lower than 1/3 the height of the teeth; cilia rudimentary or absent	peristome perfect; basal membrane often higher than 1/3 the height of the teeth; cilia (1 to)2 to 3, long
Spores	smooth or only faintly roughened	minutely papillose	nearly smooth or strongly papillose

(Mitten) Brotherus, Nat. Pfl., ed. 2, 11: 425. 1925. *Pylaisiadelpha amblystega* (Mitten) W. R. Buck, Yushania 1(2): 11. 1984. TYPE: [India.] Sikkim: *J. D. Hooker 973* (lectotype, designated here, NY; duplicate, BM). Figure 1.

Plants medium-sized to rather robust, brownish yellow or golden yellow, caespitose; main stems creeping, regularly pinnately branched; branches 0.1–0.2 mm diam., 2.4–4.2 × 0.2–0.3 mm with leaves; stem in transverse section round, ca. 0.4 mm diam., cortical cells in 3 layers, irregularly rounded, medullar cells thin-walled, irregularly rounded quadrate, central strand absent; pseudoparaphyllia few, foliose on stems and branches. Leaves dimorphic, imbricately appressed when dry, patent to squarrose when moist; stem leaves broadly lanceolate with long, slender, flexuose acumina, strongly serrate above, 1.8–2.1 × 0.3–0.5 mm; median leaf cells linear-rhomboidal, 45.77–78.88 × 3.66–5.09 μm; alar cells in an excavate group with 12 to 16 reddish brown, inflated, rectangular or subquadrate, thick-walled cells, 21.28–37.50 × 11.20–23.68 μm; branch leaves narrowly lanceolate with slender acumina, 1.2–1.4 × 0.2–0.3 mm; alar cells fewer, 6 to 12 in number. Dioicous. Inner perichaetial leaves narrowly lanceolate, long-acuminate, serrate above, 2.5–3.0 × 0.3–0.4 mm, costae absent; outer perichaetial leaves smaller. Setae reddish, smooth, twisted when dry, 3.5–4.0 cm long; capsules oblong-ovoid, ca. 1.5 mm long, 1.0 mm diam.; opercula not seen; annuli not clearly developed; peristome double; exostome teeth yellowish brown, narrowly triangular, ca. 350 μm long, coarsely papillose above, cross-striolate below; endostome segments yellow, slenderly lanceolate, keeled, nearly as long as the teeth; basal membrane high, 1/3–1/2 as high as the segments; cilia (1)2 to 3. Calyptrae not seen. Spores spherical, large, 26–31 μm diam., strongly papillose.

Gangulee (1980) reported two species of *Heterophyllium* from the Himalayas: *H. confine* (Mitten) M. Fleischer from Bhutan and *H. renitens* (Mitten) Brotherus from Sikkim. The former was synonymous with *H. affine* (Hooker) M. Fleischer by Tan and Jia (1999), while the latter is now widely accepted in the genus *Herzogiella* Brotherus (Iwatsuki, 1970). At present, only *Heterophyllium affine* is known from the Himalayas. *Heterophyllium amblystegum* is different from *H. affine* as explicitly shown in the following key.

Key to the Himalayan Species of *Heterophyllium*

1a. Plants autoicous; leaves erectopatent when moist, erect and appressed when dry; leaf apices flexuose; margins often narrowly reflexed below; alar cells differentiated by a group of enlarged, rectangular, yellowish cells; capsules slightly inclined, cylindrical, asymmetric; cilia 1 to 3; spores nearly smooth. . . . . *H. affine*

1b. Plants dioicous; leaves patent to squarrose when moist, imbricately appressed when dry; leaf apices straight or slightly recurved; margins plane; alar cells differentiated by a group of moderately inflated, subquadrate, brown or reddish brown cells; capsules erect, oblong-ovoid, symmetric; cilia (1)2 to 3; spores strongly papillose. . . . . *H. amblystegum*

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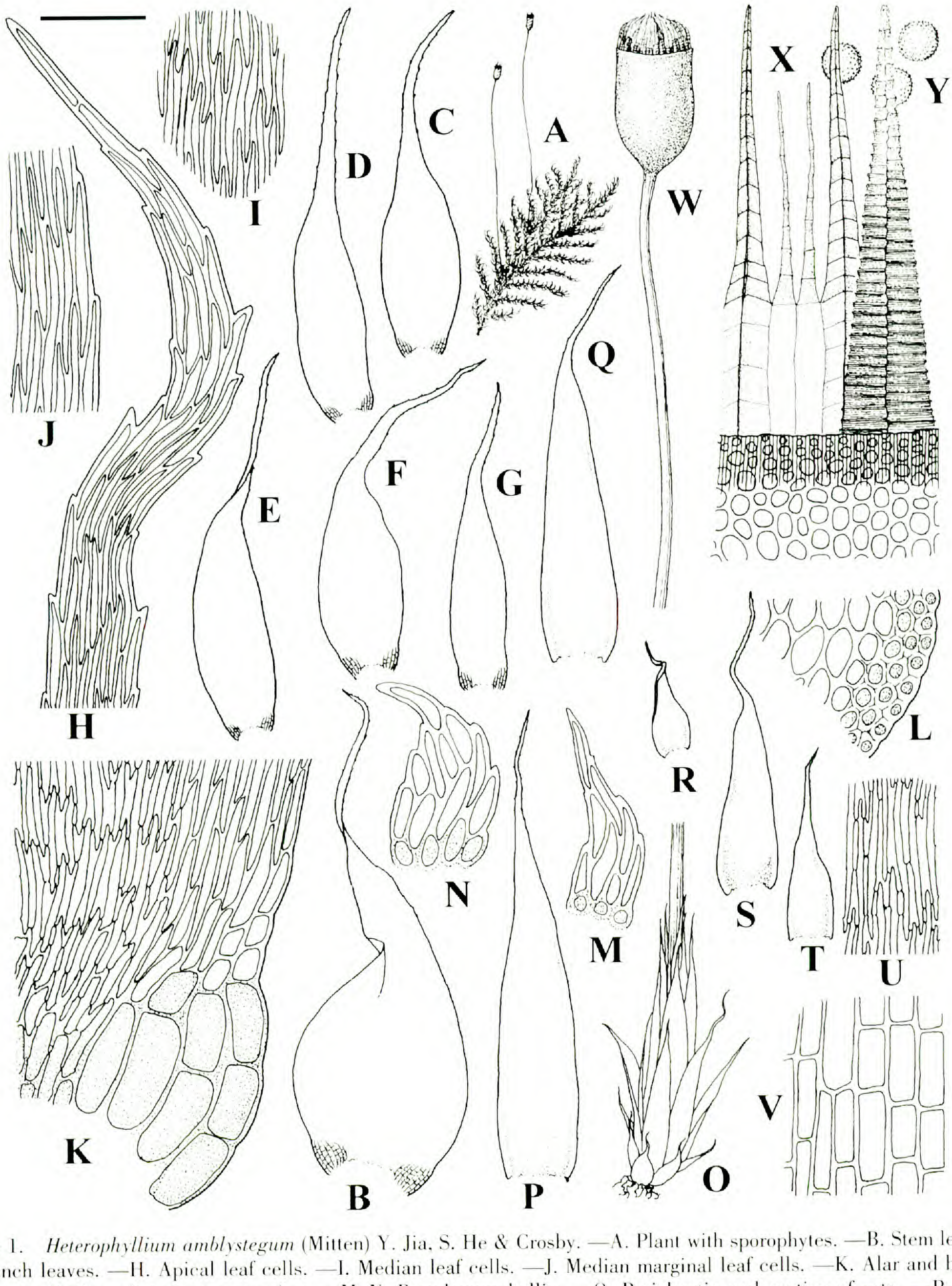

Figure 1. *Heterophyllium amblystegum* (Mitten) Y. Jia, S. He & Crosby. —A. Plant with sporophytes. —B. Stem leaf. —C–G. Branch leaves. —H. Apical leaf cells. —I. Median leaf cells. —J. Median marginal leaf cells. —K. Alar and basal leaf cells. —L. Portion of stem cross section. —M–N. Pseudoparaphyllia. —O. Perichaetia and portion of seta. —P–Q. Inner perichaetial leaves. —R–T. Outer perichaetial leaves. —U. Median perichaetial leaf cells. —V. Basal perichaetial leaf cells. —W. Capsule. —X. Portion of peristome. —Y. Spores. All drawn from the duplicate *J. D. Hooker 973* (BM). Scale bars: A = 20 mm; B–G = 0.4 mm; H–K, M–N, U–V = 55 μm; L = 45 μm; O = 0.9 mm; P–T = 0.6 mm; W = 1.45 mm; X = 85 μm; Y = 70 μm.

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Werauhia noctiflorens (Bromeliaceae), una Nueva Especie del Sureste de México y Belice

Thorsten Krömer

Estación de Biología Tropical Los Tuxtlas, Universidad Nacional Autónoma de México, Apartado Postal 94, San Andrés Tuxtla, Veracruz 95701, México. Dirección actual: Centro de Investigaciones Tropicales, Universidad Veracruzana, Interior de la Ex-hacienda Lucas Martín, Privada de Araucarias s/n, Col. 21 de Marzo, C. P. 91019 Xalapa, Veracruz, México. tkroemer@gmx.de

Adolfo Espejo y Ana Rosa López-Ferrari

Herbario Metropolitano, Universidad Autónoma Metropolitana-Iztapalapa, Apdo. Postal 55-535, C.P. 09340 México, D.F. aes@xanum.uam.mx

Amparo Acebey

Estación de Biología Tropical Los Tuxtlas, Universidad Nacional Autónoma de México, Apartado Postal 94, San Andrés Tuxtla, Veracruz 95701, México

Resumen. Se describe e ilustra *Werauhia noctiflorens* T. Krömer, Espejo, López-Ferrari & Acebey (Bromeliaceae), una nueva especie de los estados de Chiapas y Veracruz en México y del distrito de Toledo en Belice. El nuevo taxón presenta la inflorescencia simple, secunda, con las flores blancas a blanco-verdosas, laxamente dispuestas, los sépalos y pétalos grandes de hasta 3.3 y 5.5 cm de largo respectivamente, y las cápsulas fusiformes y rostradas. Se compara *W. noctiflorens* con los taxones similares *W. macrochlamys* (Mez & Wercklé) J. F. Morales, *W. pittieri* (Mez) J. R. Grant y *W. vanhyningii* (L. B. Smith) J. R. Grant.

Abstract. *Werauhia noctiflorens* T. Krömer, Espejo, López-Ferrari & Acebey (Bromeliaceae), a new species from the states of Chiapas and Veracruz in Mexico and the Toledo District in Belize, is described and illustrated. The new taxon has a simple, secund inflorescence, with white to greenish white flowers, large sepals and petals to 3.3 and 5.5 cm, respectively, and fusiform and rostrate capsules. *Werauhia noctiflorens* is compared to the similar taxa *W. macrochlamys* (Mez & Wercklé) J. F. Morales, *W. pittieri* (Mez) J. R. Grant, and *W. vanhyningii* (L. B. Smith) J. R. Grant.

Key words: Bromeliaceae, Chiapas, humid montane forest, IUCN Red List, Los Tuxtlas, Mexico, nocturnal anthesis, Veracruz, *Werauhia*.

Las Bromeliáceas en México están representadas por aproximadamente 342 especies agrupadas en 18 géneros (Espejo et al., 2004). México ocupa un lugar preponderante en la lista de los países con mayor diversidad de Bromeliáceas junto con Brasil (ca. 1200 especies) (Leme & Marigo, 1993), Ecuador (440), Perú (410), Colombia (391), Venezuela (364) y Bolivia (310) (Krömer, 2004). De los géneros presentes en México, *Tillandsia* L. es el más numeroso, con 192 especies, seguido por *Hechtia* Klotzch (49) y *Pitcairnia* L'Héritier (45). En México se tenía registro (Espejo et al., 2004) de sólo seis taxones de *Werauhia* J. R. Grant: *W. gladioliflora* (H. Wendland) J. R. Grant, *W. nocturna* (Matuda) J. R. Grant, *W. pectinata* (L. B. Smith) J. R. Grant, *W. pycnantha* (L. B. Smith) J. R. Grant, *W. vanhyningii* (L. B. Smith) J. R. Grant y *W. werckleana* (Mez) J. R. Grant. Recientemente, se advirtió la presencia en el país de *W. nutans* (L. B. Smith) J. R. Grant (Espejo et al., 2005; Krömer et al., 2005), anteriormente sólo conocida de Costa Rica.

El género *Werauhia* fue descrito por Grant (1995a) con base en 66 taxones segregados de *Vriesea* Lindley sect. *Xiphion* (E. Morren) E. Morren ex Mez. La mayoría de las especies del género presentan flores zigomorfas con antesis nocturna, sépalos coriáceos, pétalos carnosos con dos apéndices dactiloides internos basales, estigmas de tipo cupular y cápsulas septicidas fusiformes y generalmente oscuras. Como se circunscribe actualmente, *Werauhia* incluye ca. 93 especies (Barfuss et al., 2004; Grant, 1995a, b, c, 2000; Luther, 1998, 2002a, b, 2004; Morales, 2003a, 2005; Pierce, 2001; Pierce & Aranda, 2000) distribuidas desde México hasta Bolivia, aunque su centro de diversidad se ubica en Costa Rica y Panamá, de donde se conocen ca. 80 especies (Morales, 2005).

Como parte del trabajo de campo realizado en el estado de Veracruz, México, Thorsten Krömer y Amparo Acebey recolectaron dos especímenes de *Werauhia* en las faldas del volcán San Martín Tuxtla, localizado en la región nororiental de la Reserva de la Biosfera Los Tuxtlas. Al identificar dichos ejemplares, se encontró que no correspondían a ninguna de las especies del género reportadas para México. Después de una cuidadosa revisión bibliográfica (Morales, 2003b; Smith & Downs, 1977; Utley & Burt-Utley, 1994), de la consulta de bases de datos relativas a la familia (UAMIZ) y del análisis de especímenes tipo y material herborizado depositado en las principales instituciones mexicanas y extranjeras (MEXU, SEL, UAMIZ, XAL), llegamos a la conclusión de que estos ejemplares así como material adicional depositado en diferentes herbarios pertenecían a una especie no descrita, que se describe a continuación.

Werauhia noctiflorens T. Krömer, Espejo, López-Ferrari & Acebey, sp. nov. TIPO: México. Veracruz: Mun. San Andrés Tuxtla, ejido Barrio Lerdo, faldas del volcán San Martín Tuxtla, 1220 m, 18°34′N, 95°11′O, 13 Ago. 2005 (st), planta florecida en cultivo 1–6 mar. 2006 (fl), *T. Krömer & A. Acebey 2507* (holotipo, MEXU [2]; isotipos, MO, SEL, UAMIZ). Figura 1.

Herba acaulis, rosulata, 60–90 cm alta; folia vittiformia, 35–65 cm longa, 3.5–4.7 cm lata, acuta vel acuminata; inflorescentia simplex, erecta, 7- ad 12-flora, secunda, 13.5–24 cm longa; scapus 45–61 cm longus; bracteae florigerae latissime ovales vel suborbiculares, 2.5–4 cm longae, 3–4 cm latae; sepala 3–3.3 cm longa; petala alba vel albo-viridia; capsula fusiformis, apicem versus rostrata, 4–5 cm longa; seminis cauda alba praeditum.

Hierbas acaules, arrosetadas, epífitas, en flor de 60–90 cm de alto, las rosetas tipo tanque de hasta 60 cm diám. en su parte más ancha. Hojas suberectas a extendidas, 20–25, las vainas verdes a pardas claras hacia la base, oblongas a oblongo-elípticas, 6–11.5 × 5.6–6 cm, densamente pardo punctulado-lepidotas en ambas superficies, especialmente hacia la base, las láminas verdes-grisáceas, más oscuras en la haz, cintiformes, de 35–65 cm de largo, por 3.5–4.7 cm de ancho en la base, densa a moderadamente lepidotas en la base, esparcidamente punctulado-lepidotas hacia el ápice en ambas superficies, agudas a acuminadas, apiculadas, erectas. Inflorescencia terminal, erecta a inclinada, simple, secunda, el escapo cilíndrico, robusto, de 45–61 cm de largo, por 4–5 mm diám., cubierto por las vainas de las brácteas; brácteas del escapo amplexicaules, las basales cortamente foliáceas, las distales vaginiformes, las vainas de 3–5 cm, las láminas cuando presentes 2–4 cm, la espiga oblonga, 13.5–24 × 4–6 cm; brácteas florales coriáceas, verdes con finas líneas y ápice marrones, pardas cuando secas, ampliamente ovadas a suborbiculares, 2.5–4 × 3–4 cm cuando aplanadas, más largas que los entrenudos, laxamente imbricadas, inconspicuamente nervadas, lustrosas, carinadas sólo hacia el ápice, glabras externa e internamente, hialinas en el margen, agudas en el ápice. Flores divaricadas a reclinadas, de 7 a 12 por espiga, zigomorfas, pediceladas, los pedicelos muy robustos, 1–9 mm; sépalos libres, verdes, elípticos a ampliamente elípticos, 3–3.3 × 1.6–2.1 cm, ecarinados, nervados, glabros externamente, agudos a redondeados en el ápice; pétalos libres, blancos a blanco-verdosos, elípticos a oblongos, con la porción apical extendida, 5–5.5 × 2–2.3 cm, redondeados en el ápice, con dos apéndices erosos en la parte interna basal, espatuliformes, ca. 1 cm, laciniados, acuminados; estambres subiguales, más cortos que los pétalos, los filamentos blancos a blanco-verdosos, cintiformes, aplanados, 3.8–4 cm, flexuosos al secarse, las anteras amarillas, oblongas, 9–11 mm; ovario verde, ovoide, ca. 1 cm, 4.5–5 mm diám., el estilo linear, 3.4–3.5 cm, blanco-verdoso, el estigma cupulado, verde claro. Cápsula parda oscura, casi negra, de aspecto glauco, fusiforme, rostrada, 4–5 cm, ca. 1.2 cm diám.; semillas pardas claras, fusiformes, ca. 4 mm, con un apéndice plumoso blanco, ca. 1.2 cm.

Nombre común. Onahui (en Popoluca). Datos en la etiqueta del ejemplar *A. Méndez-Ton 3 5744*.

Distribución y ecología. *Werauhia noctiflorens* es conocida de los estados de Chiapas y Veracruz en México y del distrito de Toledo en Belice. En las faldas del volcán San Martín Tuxtla, Veracruz, concurre con otras especies de Bromeliáceas, como *Catopsis sessiliflora* (Ruiz & Pavón) Mez, *Tillandsia punctulata* Schlechtendal & Chamisso, *T. viridiflora* (Beer) Baker, *W. nocturna* y *W. nutans*, en el bosque mesófilo de montaña entre 1000 y 1500 m de elevación (Krömer & Acebey, 2007). En esta área, el bosque se encuentra en general bien conservado y protegido por formar parte de la zona núcleo de la Reserva de la Biosfera Los Tuxtlas, por lo cual consideramos que las poblaciones de *W. noctiflorens* no presentan presiones antrópicas severas. En la sierra de Santa Marta, la nueva especie se encuentra a una elevación cercana a los 1200 m, habitando en el bosque mesófilo de montaña en tanto que en Chiapas prospera en los mismos bosques pero entre 800 y 1000 m. Las plantas de *W. noctiflorens* son relativamente raras y crecen generalmente dispersas sobre los troncos de los árboles, a diferencia de otras especies como *W. nocturna* y *W. nutans*, que debido a su vigorosa reproducción vegetativa, son localmente abundantes y forman colonias densas principalmente en el sotobosque.

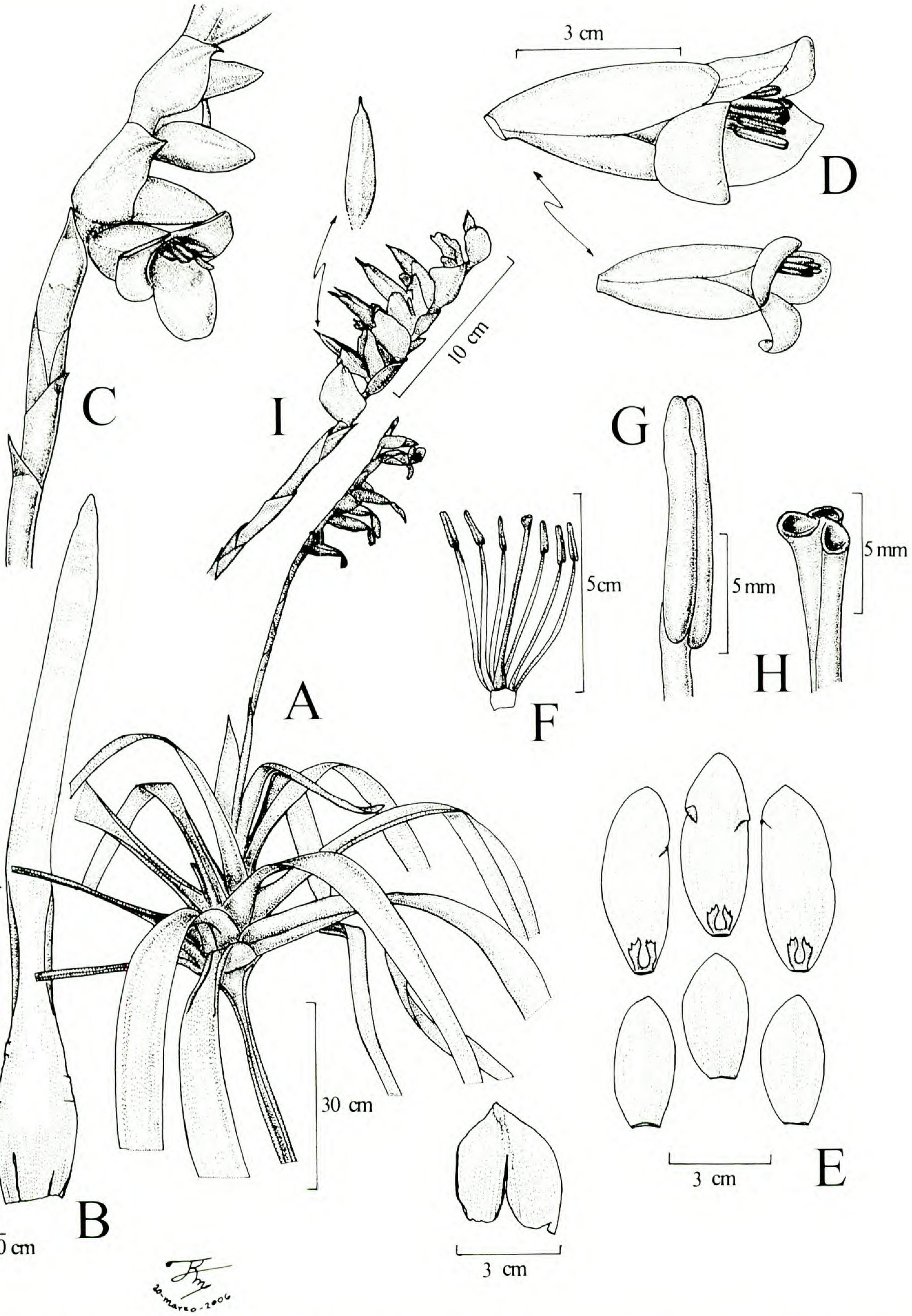

Figura 1. *Werauhia noctiflorens* T. Krömer, Espejo, López-Ferrari & Acebey. —A. Hábito. —B. Hoja. —C. Detalle de la inflorescencia. —D. Flor. —E. Pétalos, sépalos y bráctea floral disecados. —F. Androceo y ginecco. —G. Antera. —H. Estigmas. —I. Infrutescencia. Ilustración basada en el holotipo, *T. Krömer & A. Acebey 2507* (MEXU).

Estado de conservación. Por lo que se refiere a la evaluación de su estado de conservación, se puede considerar que *Werauhia noctiflorens* tiene un área de distribución no muy restringida en los bosques mesófilos desde el sur del estado de Veracruz en México hasta Belice y podría estar muy probablemente presente en Guatemala. Por otro lado, este hábitat es uno de los más amenazados debido a su reemplazo por cultivos, pastizales y vegetación secundaria; en México el bosque mesófilo ocupa ca. 1,735,000 ha., lo que corresponde al 0.89% de su superficie total reportada (Palacios-Prieto et al., 2000). Sin embargo, debido a la falta de datos adecuados sobre su distribución general y a la ausencia de datos poblacionales sugerimos que por el momento la nueva especie sea incluida en la categoría de Datos Insuficientes (DD) de la UICN (2001).

Muchas especies de *Werauhia* son polinizadas por murciélagos y presentan un síndrome floral caracterizado por flores relativamente grandes, acampanadas, con brácteas verdes y pétalos blancos, blanco-verdosos o amarillo-verdosos (Grant, 1995a; Benzing, 2000; Krömer, 2004). Lo anteriormente mencionado es el caso de *W. noctiflorens* cuya floración ocurre en marzo y abril. Las pocas (de 7 a 12) flores blanco-verdosas se abren al atardecer, casi siempre en días consecutivos, sin emitir ningún olor especial, ofreciendo una gran cantidad de néctar transparente. En la región de Los Tuxtlas, esta especie es probablemente polinizada por algunos de los cuatro murciélagos nectarívoros especializados (Phyllostomidae: Glossophaginae) que ocurren en esta área (Estrada & Coates-Estrada, 2001). De manera similar a *W. gladioliflora*, especie con quiropterofilia bien documentada y con amplia distribución en las tierras bajas del Neotrópico (Tschapka & von Helversen, en prensa), las flores de *W. noctiflorens* pueden encajar como una máscara en el rostro alargado de los murciélagos nectarívoros, así como la exposición de la inflorescencia erecta da espacio para los movimientos de las alas durante el vuelo sostenido y el acto de alimentación (Krömer, 2004).

Etimología. El nombre de la nueva especie hace alusión a la antesis nocturna de sus flores y significa "La que florece de noche".

De acuerdo con la clasificación infragenérica propuesta por Grant (1995a), *Werauhia noctiflorens* pertenece a la sección *Werauhia* J. R. Grant. Además, según la clave propuesta para el género por Utley y Burt-Utley (1994), en su tratamiento de la familia para la *Flora Mesoamericana*, la nueva especie muestra semejanzas con *W. macrochlamys* (Mez & Werckl é) J. F. Morales, *W. pittieri* (Mez) J. R. Grant y *W. vanhyningii*. Todos estos taxones comparten caracteres morfológicos tales como inflorescencias simples y

Tabla 1. Comparación de morfología y distribución de *Werauhia noctiflorens* con especies similares. Datos según Utley and Burt-Utley (1994) y *Espejo et al. (2005).

	W. noctiflorens	*W. macrochlamys*	*W. pittieri*	*W. vanhyningii*
Láminas foliares	35–65 × 3.5–4.7 cm, agudas a acuminadas, apiculadas	30–82 × 4–4.7 cm, agudas a acuminadas	38–70 × 2.8–3.4(–4) cm, agudas a acuminadas	28–45 (13–27*) × 2.6–2.8 (2–2.7*) cm, atenuadas a largamente mucronadas
Escapo	45–61 cm de largo	40–65 cm de largo	45–55 cm de largo	28–38 (23–25*) cm de largo
Inflorescencia	13.5–24 cm de largo, simple, con las flores laxamente dispuestas	14–26 cm de largo, simple, con las flores densamente dispuestas	9–20 cm de largo, simple, con las flores densamente dispuestas	10–17 (5–13*) cm de largo, simple, con las flores laxamente dispuestas
Brácteas florales	2.5–4 cm de largo, carinadas	3–4 cm de largo, ecarinadas	3.3–4.2 cm de largo, ecarinadas	3.3–4.3 (2.9–4.2*) cm de largo, ecarinadas
No. de flores	7–12	8–13	6–20	8–11 (4–9*)
Sépalos	3–3.8 cm de largo	2.4–3 cm de largo	1.7–2.8 cm de largo	2.1–2.4 (2.4–2.6*) cm de largo
Cápsulas	4–5 cm de largo, fusiformes, rostradas	2.2–3.3 cm de largo subcilíndricas, truncadas	3–4 cm de largo, fusiformes, rostradas	2–2.5 (2.9–4.2*) cm de largo, ovoides a elipsoides, cortamente mucronadas
Coma de la semilla	blanca	crema	ferrugínea	ferrugínea (pardo-dorada a amarillenta*)
Distribución	Belice y México (Chiapas, Veracruz)	Costa Rica	Costa Rica y Panamá	México (Chiapas, Oaxaca, Puebla, Veracruz)
Intervalo altitudinal (m)	700–1500	2000–2300	2400–2600	140–2100 (920–1720*)

secundas, brácteas pardas a pardas claras cuando secas, láminas foliares de tamaño y forma similares, etc. Sin embargo, *W. noctiflorens* se distingue de dichos taxones por sus flores más grandes (sépalos 3–3.3 vs. máximo 3 cm de largo), por sus brácteas florales carinadas (vs. ecarinadas) y por las comas blancas (vs. coloreadas) de las semillas (Tabla 1). Adicionalmente, *W. noctiflorens* se distingue de *W. macrochlamys* y *W. pittieri* por presentar inflorescencias con las flores laxamente (vs. densamente) dispuestas, por sus cápsulas más grandes (4–5 vs. máximo 4 cm de largo) y por su intervalo altitudinal más bajo (700–1500 vs. mínimo 2000 m). De *W. vanhyningii*, la cual crece en México en altitudes similares, *W. noctiflorens* se distingue por sus hojas más largas (35–65 vs. 13–27 cm de largo) y por su escapo más largo y robusto (45–61 vs. 23–25 cm de largo).

Paratipos. BELICE. **Toledo**: Columbia River Forest Reserve, 700 m, *B. Holst 5713* (SEL). MÉXICO. **Chiapas**: Mun. Ocosingo, en laguna Ocotalito, 12 km N de Monte Líbano, camino a Najá, *E. Martínez M-21260* (MEXU); Mun. Tila, pie del cerro Tak'abana, *A. Méndez-Ton* (*Alush Shilom Ton*) *3 5744* (MEXU). **Veracruz**: Mun. San Andrés Tuxtla, cerro del San Martín, *J. I. Calzada 584* (MEXU); Mun. San Andrés Tuxtla, volcán San Martín Tuxtla, *R. Cedillo 3130* (MEXU), *3154* (MEXU); Mun. Soteapan, Santa Marta, vertiente SO de la sierra de Santa Marta, *M. Sousa 3588* (MEXU [2]); Mun. San Andrés Tuxtla, ejido Barrio Lerdo, faldas del volcán San Martín Tuxtla, 1500 m, *T. Krömer & A. Acebey 2207* (MEXU, SEL, XAL).

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Subspecies of *Rosa nutkana* and *R. woodsii* (Rosaceae) in Western North America

Walter H. Lewis
Washington University, Department of Biology, St. Louis, Missouri 63130, U.S.A., and Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
Lewis@biology.wustl.edu

Barbara Ertter
University and Jepson Herbarium, University of California, 1001 Valley Life Science Bldg. 2456, Berkeley, California 94720-2465, U.S.A., and Research Associate, Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A. ertter@calmail.berkeley.edu

Abstract. Three subspecies of *Rosa nutkana* C. Presl and five of *R. woodsii* Lindley are recognized in western Canada and the United States, including four changes in combination and/or status: *Rosa nutkana* subsp. *melina* (Greene) W. H. Lewis & Ertter, *R. woodsii* subsp. *arizonica* (Rydberg) W. H. Lewis & Ertter, *R. woodsii* subsp. *manca* (Greene) W. H. Lewis & Ertter, and *R. woodsii* subsp. *gratissima* (Greene) W. H. Lewis & Ertter. *Rosa nutkana* subsp. *melina* and *R. woodsii* subsp. *manca* occur at high elevations of the southern Rocky Mountains and Colorado Plateau of Colorado and Utah with outlying populations in Arizona, Idaho, New Mexico, and Wyoming; *R. woodsii* subsp. *arizonica* is found at lower elevations of Arizona and the Colorado Plateau; and *R. woodsii* subsp. *gratissima* occurs in the mountains surrounding the Mojave Desert and southern Great Basin of California and Nevada, with its variety *glabrata* (Parish) D. Cole confined to the San Bernardino Mountains of California. Synonyms are provided for appropriate subspecies, 14 lectotypes and one neotype are designated here, and selected exsiccatae are given for newly recognized subspecies. The following names are lectotypified: *Rosa bakeri* Rydberg, nom. illeg., *R. californica* Chamisso & Schlechtendal var. *ultramontana* S. Watson, *R. deserta* Lunell, *R. fendleri* Crépin, *R. macounii* Greene, *R. maximiliani* Nees, *R. megalantha* G. N. Jones, *R. neomexicana* Cockerell, *R. nutkana* var. *alta* Suksdorf, *R. nutkana* var. *hispida* Fernald, *R. nutkana* var. *pallida* Suksdorf, *R. rainierensis* G. N. Jones, *R. spaldingii* Crépin ex Rydberg, and *R. subnuda* Lunell. One neotype is designated: *Rosa woodsii* Lindley.

Key words: *Rosa*, Rosaceae, Western North America.

Rosa nutkana C. Presl and *R. woodsii* Lindley are two of the most widely distributed and variable species of *Rosa* L. in western Canada and the United States. Their diversity is particularly evident at higher elevations throughout the southern Rocky Mountains, including outlying mountainous peaks and ridges, and adjacent basins. In recognition of this diversity, both species have been divided into subspecies characterized by well-defined core morphological features within ecogeographic regions. Plants with intermediate characters may occur occasionally in transitional areas between such zones. Our treatment follows those of Piper (1906) for *R. nutkana* and Taylor and MacBryde (1978) for *R. woodsii*, who recognized *R. nutkana* subsp. *macdougalii* (Holzinger) Piper and *R. woodsii* subsp. *ultramontana* (S. Watson) R. L. Taylor & MacBryde, respectively, as subspecies distinct from their autonyms. Both subspecies occur within the intermontane region between the Rocky Mountains to the east and the Cascade Mountains to the west, with the former primarily restricted to forested areas, while the latter is widespread in riparian sites in the sagebrush zone. In parallel within the high montane ecogeographic region of the southern Rocky Mountains and Colorado Plateau, the two species have also evolved distinct subspecies, which we name *R. nutkana* subsp. *melina* (Greene) W. H. Lewis & Ertter and *R. woodsii* subsp. *manca* (Greene) W. H. Lewis & Ertter, while another *R. woodsii* allied to subspecies *manca*, named subspecies *arizonica* (Rydberg) W. H. Lewis & Ertter, occurs at lower elevations often in montane and plateau riparian habitats of Arizona and adjacent states to the north and east. The subspecies *R. woodsii* subsp. *gratissima* W. H. Lewis & Ertter and its variety *glabrata* (Parish) D. Cole occur to the west in areas in and surrounding the Mojave Desert and southern Great Basin.

Infraspecific taxa in *Rosa* are used by us at three levels: subspecies, variety, and infrequently forma,

although in this treatment only the first two ranks are used, with an emphasis on subspecies. Different subspecies occupy substantial ranges of a species in at least two distinct ecogeographic regions where populations possess distinct morphological characteristics. Such regions are often contiguous, which allows limited gene flow in transitional areas through hybridizing and backcrossing. Physical and other barriers may exist, however, so that differing subspecific populations may be allopatric with consequent isolation and only limited or no gene exchange. Therefore, important features of these subspecific regions are their distinct geography and ecology. For example, with its wide geographic range within the Great Basin, sagebrush (*Artemisia tridentata* Nuttall) also has a broad ecological distribution from dry valley floors to mesic mountaintops, where precipitation is double or triple that of the valley. Three major subspecies (Shultz, 2006) associated with considerable adaptive radiation in both physiological and morphological traits relative to water availability that lead to successful adaptation to drought (Kolb & Sperry, 1999) are found along this gradient. These differences also reflect genetic uniqueness of the subspecies based on common garden experiments. Moreover, ploidy levels differ between subspecies with diploids found at the highest level having moist soils, tetraploids at the lowest level with dry soils, and the intermediate subspecies with mixed diploid/tetraploid populations and an intermediate habitat. Undoubtedly, the evolution of these tetraploids is an example of the adaptive advantage of polyploids able to survive and expand under the harshest of drought conditions (Lewis, 1980). In summary, this is one of the most complete characterizations detailing subspecific successes of a species through physiological, anatomical, and cytogenetic adaptations, while confirming their distinctions based on morphologic, ecologic, and geographic data. This research further illustrates the evolutionary dynamics of populations within well-defined subspecies. Although *R. nutkana* and *R. woodsii* also illustrate clear subspecific distinctions based on morphologic, geographic, and ecologic (habitat) data and concomitant evolutionary lineages, experimental information comparable to that known for *A. tridentata* is not yet available.

Our treatment provides one example of the use of variety to characterize a cluster of populations having a relatively minor, but nevertheless distinctive, morphological variation within typical *Rosa woodsii* subsp. *gratissima* populations. This variant, called variety *glabrata*, having glabrous leaflets (abaxial), rachis/petioles, and stipules, contrasts with the typical variety with puberulent to pubescent leaflets (abaxial) and associated parts. Furthermore, variety *glabrata* is unique to a small geographic area of the subspecies in the San Bernardino Mountains of California. This example illustrates one of several possible instances whereby varietal rank is applicable in *Rosa* taxonomy.

The following synopsis of *Rosa nutkana* and *R. woodsii* consists of keys to subspecies, comprehensive synonymy, and representative exsiccatae of new subspecies and one variety. Fourteen lectotypes and one neotype are designated, including designations for those protologues that used both flowering and fruiting specimens as type, the flowering material collected usually in May or June and the fruiting material in September or October within a given year. Some are mounted separately and other mountings include flowering and fruiting material together; if the latter, they are readily distinguished by flowering and/or early hypanthium development and green leaflets or by fruiting (hips) and yellowish leaflets, while the other gatherings of each cited in the protologue are syntypes. Should lectotype and syntype be mounted on the same sheet, these are noted with pro parte (p.p.) followed by the information for either flower (fl) or fruit (fr). Such syntypes are provided in text following the nomenclature of appropriate subspecies.

1. Rosa nutkana C. Presl, Epim. Bot. 203. 1851. TYPE: Canada. British Columbia: Vancouver Island, Nootka Sound, Aug. 1791, *T. P. X. Haenke s.n.* (holotype, PR, PR photo at MO).

KEY TO THE SUBSPECIES OF *ROSA NUTKANA* IN WESTERN NORTH AMERICA

1a. Shrubs short, 0.4–1.0(–1.5) m tall; fertile branches armed with curved or sometimes straight prickles, or rarely unarmed; sepal outer surfaces mostly stipitate-glandular; higher elevations of southern Rocky Mtns. and adjacent peaks and ridges (2500–3800+ m). . . . . subsp. *melina*

1b. Shrubs taller, 1–3 m tall, occasionally shorter; fertile branches armed with straight or rarely curved prickles, or unarmed; sepal outer surfaces stipitate-glandular or eglandular; common at lower elevations (below 2500 m).

2a. Fertile branches not dense, often with long internodes (to 6.5 cm), commonly unarmed or with infrastipular prickles; leaflets usually eglandular below and singly serrated without gland tips; sepals commonly eglandular; intermontane between the Cascade and Rocky Mtns. . . . . subsp. *macdougalii*

2b. Fertile branches often dense with shorter internodes, armed with paired infrastipular prickles, infrequently unarmed; leaflets often glandular below and commonly bi- or multiserrated and gland tipped; sepals commonly stipitate-glandular; Pacific coast from Alaska to northern California west of the Cascade Mtns. . . . . subsp. *nutkana*

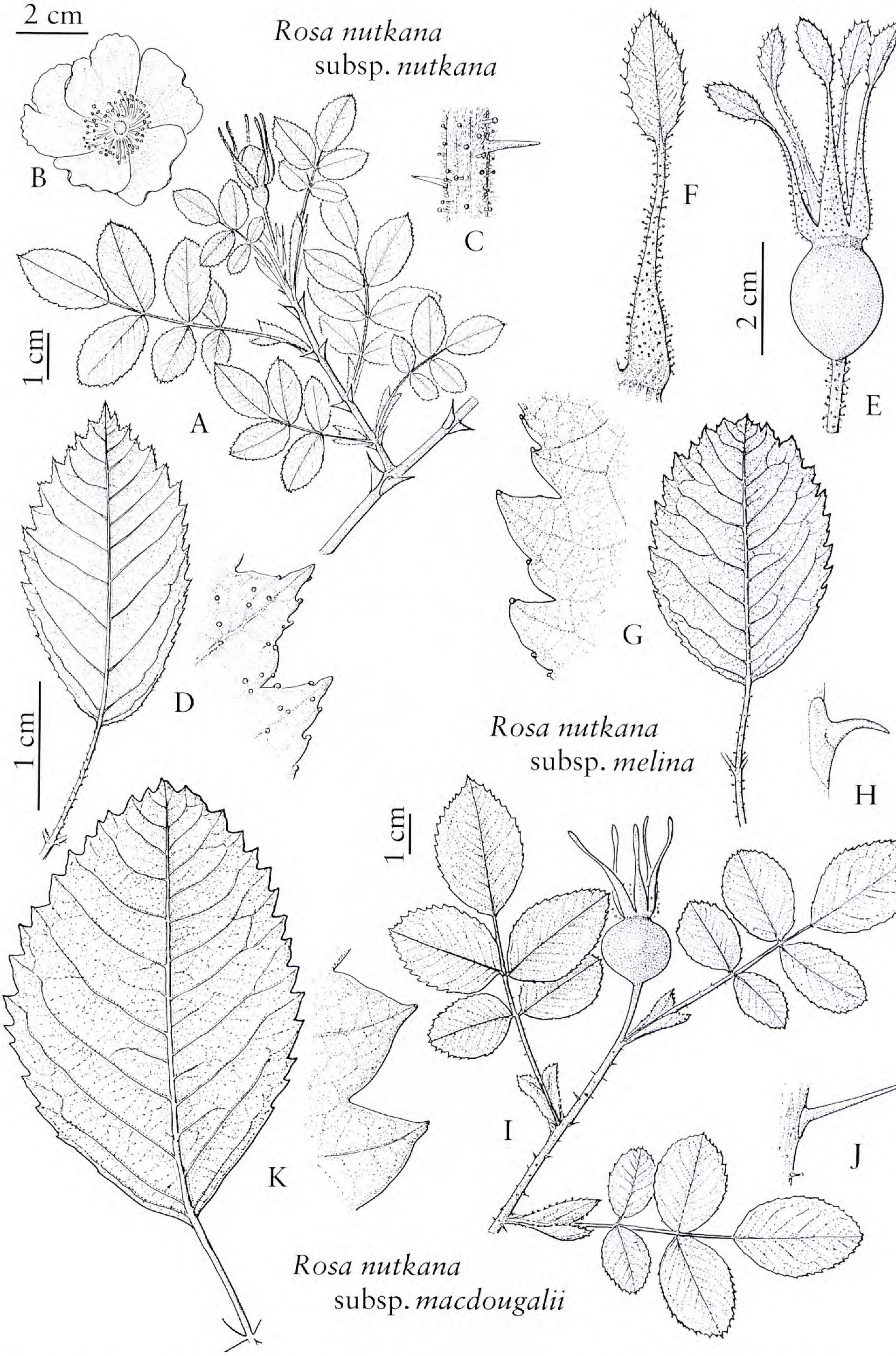

Figure 1. *Rosa nutkana* C. Presl subspecies. A–D. Subspecies *nutkana*. —A. Flowering branch. —B. Flower. —C. Upper branch detail. —D. Terminal leaflet with serrations. E–H. Subspecies *melina* (Greene) W. H. Lewis & Ertter. —E. Hip with sepals. —F. Enlarged sepal. —G. Terminal leaflet with serrations. —H. Curved prickle single or paired. I–K. Subspecies *macdougalii* (Holzinger) Piper. —I. Fruiting branch. —J. Straight prickle. —K. Terminal leaflet with serrations. A–D drawn from *Zeller 781* (MO); E–H drawn from *Heil & Mietty 20197* (SJNM); I–K drawn from *Kirkwood 11180* (MO); all by J. Myers.

1a. Rosa nutkana subsp. **nutkana** C. Presl. Figure 1A–D.

Rosa aleutensis Crépin, Bull. Soc. Roy. Bot. Belgique 15: 48. 1876. TYPE: U.S.A. Alaska: Aleutians West Co., Unalaska Island (as "Ile d'Unalaschka"), 1846, *P. K. N. S. Turczaninow s.n.* (holotype, BR; isotype, LE not seen).

Rosa caryocarpa Douglas ex Crépin, Bull. Soc. Roy. Bot. Belgique 15: 39. 1876, nom. inval., pro syn. sub *R. nutkana* C. Presl.

Rosa durandii Crépin, Bull. Soc. Bot. France 22: 19. 1875. TYPE: U.S.A. Oregon: s. loc., 1871, *E. Hall 146* (holotype, P-Durand herbarium; isotypes, BR [fragment], F 455214, GH 32569, K, MO 1951280, NY 743773).

Rosa lyalliana Crépin, Bull. Soc. Roy. Bot. Belgique 16: 39. 1876, nom. inval., pro syn. sub *R. nutkana* C. Presl.

Rosa muriculata Greene, Leafl. Bot. Obs. Crit. 2: 263. 1912. *Rosa nutkana* var. *muriculata* (Greene) G. N. Jones, Madroño 3: 128. 1935. TYPE: U.S.A. Washington: Cowlitz Co., near Woodland, 15 July 1898, *F. V. Coville 705* (holotype, US 80003; isotype, NY 335710 [fragment]).

Rosa nutkana var. *setosa* G. N. Jones, Madroño 3: 129. 1935. Syn. nov. TYPE: U.S.A. Washington: Island Co., Rocky point near Deception Pass, Whidbey Island, 2 June 1934, *G. N. Jones 4908* (holotype, WTU 15784).

Rosa caryocarpa was collected by David Douglas in 1825 along the banks of the Columbia River in either Oregon or Washington, U.S.A. Sheets bearing his writing are at BM and K (Herb. Bentham 1854). The name otherwise appears only in Crépin's (1876: 39) synonymy of *R. nutkana*.

As part of the Oregon Boundary Commission activities along the United States and Canada border from Montana to British Columbia, David Lyall collected material from Vancouver Island and the Lower Fraser River, British Columbia, which Crépin named *Rosa lyalliana* in his honor on sheets at BR and BM. The name was provided by Crépin (1876: 39) as a synonym of *R. nutkana*. This naming also highlighted the joint American/British survey of the Northwest from Montana to British Columbia during 1857–1861 when many plants and animals were collected (Lyall, 1863). Most, if not all, collections and documents made by Lyall and other British survey members were returned to London where they were widely dispersed (to GH in North America), while documentations and collections obtained by the American Commission over this entire period were essentially lost.

The West Coast *Rosa nutkana* subsp. *nutkana* ranges from coastal Alaska south to northern California generally west of the Cascade Mountains.

1b. Rosa nutkana C. Presl subsp. **macdougalii** (Holzinger) Piper, Contr. U.S. Natl. Herb. 11: 335. 1906. *Rosa macdougalii* Holzinger, Contr. U.S. Natl. Herb. 3: 223. 1895. TYPE: U.S.A. Idaho: Kootenai Co., canyons near Farmington Landing, S end of Lake Coeur d'Alene, 7 July 1892, *J. H. Sandberg, D. T. MacDougal & A. A. Heller 572* (holotype, US 239980; isotypes, A, BR, DS 106275, F 124416, MO 775326, NA, NY 335711 & 415851, PH). Figure 1I–K.

Rosa anatonensis H. St. John, Fl. Southeast Wash. & Idaho 206. 1937 (as "anatonesis"). TYPE: U.S.A. Washington: Asotin Co., SW of Anatone, 850 m, 30 May 1928, *H. St. John & R. Palmer 9555* (holotype, WS 67719; isotypes, GH 32553, NY 415907, UC 544889, US 1654731, WS 67864 & 67865, WTU 31915).

Rosa brownii Rydberg, Bull. Torrey Bot. Club 44: 70. 1917. TYPE: U.S.A. California: Siskiyou Co., N side of Mt. Shasta, 1524–2743 m, 11–16 June 1897, *H. E. Brown 349* (holotype, NY 345434; isotypes, MO 1951258, NY 345435, US 299325).

Rosa caeruleimontana H. St. John, Fl. Southeast Wash. & Idaho 207. 1937. TYPE: U.S.A. Washington: Asotin Co., Blue Mtns., 15 June 1928, *G. N. Jones 1892* (holotype, WS 67855; isotypes, BM, CAS, ILL not seen, SIU not seen, UC 544888, WS 67856 & 67857).

Rosa columbiana Rydberg, N. Amer. Fl. 22: 514. 1918. Syn. nov. TYPE: U.S.A. Idaho: Latah Co., valley of Little Potlatch River, 13 June 1892, *J. H. Sandberg, D. T. MacDougal & A. A. Heller 381* (holotype, NY 415921; isotype, MO 775380).

Rosa delitescens Greene, Leafl. Bot. Observ. Crit. 2: 265. 1912. Syn. nov. TYPE: U.S.A. Oregon: Jackson Co., Siskiyou Mtns., 3 Sep. 1889, *E. L. Greene s.n.* (holotype, NDG 23506).

Rosa jonesii H. St. John, Fl. Southeast Wash. & Idaho 207. 1937. TYPE: U.S.A. Washington: Latah Co., summit of Moscow Mtn., 26 June 1928, *H. St. John & G. N. Jones 9621* (holotype, WS 67852; isotypes, F 821225, GH 32582, MIN 332732, P, RM 143117, UC 544890, US 1654699, WS 67851 & 67853, WTU 31922).

Rosa macrocarpa Nuttall ex Rafinesque, Med. Bot. 2: 258. 1830, nom. illeg., non F. V. Mérat, Nouv. Fl. Env. Paris 190. 1812. Syn. nov. U.S.A. Oregon or Washington: Columbia River, s.d., *Nuttall s.n.* (holotype, GH).

Rosa megacarpa Nuttall ex Torrey & A. Gray, Fl. N. Amer. 1: 460. 1840, nom. inval., pro syn. sub *R. fraxinifolia* Borkhausen.

Rosa megalantha G. N. Jones, Proc. Biol. Soc. Wash. 41: 194. 1928. *Rosa spaldingii* var. *alta* G. N. Jones, Madroño 3: 132. 1935. Syn. nov. TYPE: U.S.A. Washington: Spokane Co., Spokane, Lincoln Park, 600 m, 17 June (fl) & 10 Oct. 1927 (fr), *G. N. Jones 614* (lectotype, designated here, 17 June 1927 [fl], WS 44430; isotypes, NY 743772, US 1924116, WS 43531, WTU 22024).

Rosa nutkana var. *alta* Suksdorf, Werdenda 1: 23. 1927. Syn. nov. TYPE: U.S.A. Washington: Klickitat Co., Bingen, 25 May & 27 Oct. 1922, *W. Suksdorf 10821* (lectotype, designated here, 27 Oct. 1922 [fr], MO 952023; isotypes, BM, GH 32597, K p.p. [fr], MIN 584249 p.p. [fr], NY 415857 p.p. [fr], PH 654914 p.p. [fr], UC 351907 p.p. [fr], WS 121329 sheet 2, WTU 196772 p.p. [fr]).

Rosa nutkana var. *hispida* Fernald, Bot. Gaz. 19: 335. 1894. *Rosa spaldingii* var. *hispida* (Fernald) G. N. Jones,

Madroño 3: 130. 1935. Syn. nov. TYPE: U.S.A. Montana: Rock Creek, 17 July 1880, *S. Watson 124* (lectotype, designated here, GH 32593).

Rosa nutkana var. *pallida* Suksdorf, Werdenda 1: 23. 1927. Syn. nov. TYPE: U.S.A. Washington: Klickitat Co., Falcon Valley, 21 June & 14 Oct. 1919, *W. Suksdorf 10244* (lectotype, designated here, 21 June 1919 [fl], MO 952924; isotypes, BM, GH 32585 p.p. [fl], K p.p. [fl], NY 415858 p.p. [fl], PH 654932 p.p. [fl], UC 351877, US 1438016, WS 121268 p.p. [fl], WTU 196828 & 196771 p.p. [fl]).

Rosa rainierensis G. N. Jones, Univ. Wash. Publ. Biol. 7: 103, 174. 1938. TYPE: U.S.A. Washington: Lewis Co., Mt. Rainier, Goat Mtn., 1370 m, 11 July & 19 Oct. 1897, *O. D. Allen 292* (lectotype, designated here, 11 July 1897 [fl], WS 13052 p.p. [fl]; isotypes, MO 1951279 p.p. [fl], NY 415878 p.p. [fl], WTU 38311 p.p. [fl]).

Rosa spaldingii Crépin ex Rydberg, Flora Rocky Mts. 442. 1917. TYPE: U.S.A. Idaho (as Oregon): Clear Water (as Lapwai), *Rev. Spalding s.n.* (lectotype, designated here, BR; isotypes, BM, GH, K, P, PH).

Rosa spaldingii var. *chelanensis* G. N. Jones, Madroño 3: 133. 1935. Syn. nov. TYPE: U.S.A. Washington: Chelan Co., along Wenatchee River, near Cashmere, 23 Aug. 1927, *G. N. Jones 1402* (holotype, WTU 356692; isotype, WTU 356693 not seen).

Rosa spaldingii var. *parkeri* H. St. John, Fl. Southeast Wash. & Idaho 210. 1937. Syn. nov. TYPE: U.S.A. Idaho: Latah Co., Grizzly Camp, 2 July 1922, *C. S. Parker 503* (holotype, WS 47857; isotype, F).

Besides being illegitimate, publication of *Rosa macrocarpa* is certainly doubtful, for Rafinesque's description is limited to fruit the "size of pigeon egg, very good," and no subsequent description is known.

Rosa megacarpa was named by Nuttall for material he collected in Oregon (now Oregon or Washington) in open woods. Torrey and Gray (1840: 460) placed it in synonymy of *R. fraxinifolia* Borkhausen and mistakenly considered the collection to be of coastal origin. Nuttall's material at K is clearly *R. nutkana* from east of the Cascade Mountains (= subsp. *macdougalii*). It is most unfortunate that Torrey and Gray decided not to publish Nuttall's new species and description, for *R. megacarpa* would have predated C. Presl's *R. nutkana* by 11 years.

In his protologue, Jones provided two collections (both *Jones 614*) of *Rosa megalantha*: the flowering collection (17 June 1927) is designated lectotype in part because Jones noted in his protologue "conspicuous for its numerous, large, fragrant flowers," while the fruiting material was not mentioned. Further, numerous isolectotypes of flowering material have been distributed, while only two collections of fruiting material are known at one institution (syntype 10 Oct. 1927 [fr] at WS 43530 and 43532).

Of Suksdorf's (*10821*) two collections of *R. nutkana* var. *alta*, fruiting material (12 Oct. 1922) is somewhat more widely distributed than flowering (25 May 1922); as both sets are diagnostically equivalent, the former is selected lectotype with its more numerous isolectotypes. Syntypes of 25 May (fl) are at GH 32596, K p.p. (fl), MIN 584249 p.p. (fl), NY 415857 p.p. (fl), PH 654914 p.p. (fl), WS 121329 sheets 3 and 4, and WTU 196772 p.p. (fl).

Suksdorf 10244 is the basis of *Rosa nutkana* var. *pallida*; there is no particular reason for selecting the flowering collection (21 June 1919) lectotype except that it is available at MO, and only flowering material is mounted on this sheet. Syntypes of 14 Oct. 1919 (fr) are at GH 32585 p.p. (fr), K p.p. (fr), NY 415858 p.p. (fr), GH 654932 p.p. (fr), UC 351907 p.p. (fl), WS 121268 p.p. (fr), and WTU 196828 & 196771 p.p. (fr).

Fernald cited three syntypes of *Rosa nutkana* var. *hispida* in his protologue, of which the earliest collection made by S. Watson and deposited in his and Fernald's institutional herbarium (GH) is selected lectotype, while *C. V. Piper 1540* (Washington: Whitman Co., Pullman) represented by collections of 25 June 1893 (GH 32591) and September 1893 (not seen) are syntypes.

Flowering material of *Rosa rainierensis* at Jones's institutional herbarium is diagnostic and selected lectotype with numerous isolectotypes. Syntypes of 19 Oct. 1897 (fr) are at MO 1951279 p.p. (fr), NY 415878 p.p. (fr), WS 13052 p.p. (fr), and WTU 38311 p.p. (fr).

The selected lectotype of *Rosa spaldingii* at BR bears Crépin's annotation and is not complicated by having flowering and fruiting material mounted together as, for example, the isolectotype at BM.

The intermontane *Rosa nutkana* subsp. *macdougalii* occurs from central British Columbia east of the Cascade Mountains in Canada to northern California, east to Montana and Wyoming, and south to Colorado and Utah in the United States.

1c. Rosa nutkana C. Presl subsp. **melina** (Greene) W. H. Lewis & Ertter, comb. et stat. nov. Basionym: *Rosa melina* Greene, Pittonia 4: 10. 1899. TYPE: U.S.A. Colorado: Montrose Co., Cerro Summit, near Cimarron, 30 Aug. 1896, *E. L. Greene s.n.* (holotype, NDG 23707). Figure 1E–H.

Rosa oreophila Rydberg, Bull. Torrey Bot. Club 31: 561. 1904. Syn. nov. TYPE: U.S.A. Colorado: Routt Co., Four-miles Hill, 2590 m, 22 July 1896, *C. F. Baker s.n.* (holotype, NY 415860; isotypes, MO 1951203, NDG 23560, NY 415862).

Rosa pandorana Greene ex Rydberg, Fl. Colorado 190–191. 1906. Syn. nov. TYPE: U.S.A. Colorado: San Miguel Co., region of Gunnison Watershed, Pandora, 10 Aug. 1901, *C. F. Baker 751* (holotype, US 412379; isotypes, GH 32605, K, MIN 131154, MO 123831, NY 415866, RM [2 sheets]).

Rosa underwoodii Rydberg, Bull. Torrey Bot. Club 31: 560. 1904. Syn. nov. TYPE: U.S.A. Colorado: Ouray Co., W

of Ouray, above Box Cañon, 2300–2700 m, 8 Sep. 1904, *L. M. Underwood & A. D. Selby 122* (holotype, NY 429915).

When at US, E. L. Greene named the *C. F. Baker 751* sheet "*Rosa pandorana* Greene n. sp.," which was later published by P. A. Rydberg in the *Flora of Colorado*. This sheet is holotype with isotypes recorded at six herbaria. Later, Rydberg (1918: 513) reduced *R. pandorana* to synonymy of *R. melina* Greene (= *R. nutkana* subsp. *melina*).

On sheets at NDG, Greene also annotated certain collections identifiable as *Rosa nutkana* subsp. *melina* using the names *Rosa pudica* (U.S.A. Colorado: Chaffee Co., Marshall Pass, 3310 m, 20 Aug. 1902, *C. F. Baker 872*) or *Rosa stygia* (U.S.A. Colorado: Gunnison Co., Black Cañon, 27 June 1901, *C. F. Baker 263*). These and other Baker collection sets are widely distributed.

Rosa nutkana subsp. *melina* is endemic to high mountains of Colorado, New Mexico, and Utah and rare in southeastern Idaho, Montana, and Wyoming, often on isolated peaks and ridges in or at edges of aspen, fir, spruce, and/or pine forests at elevations of 2500–3800+ m. This distribution, to some degree, includes the subspecies in the Southern Rocky Mountain Floristic Element (McLaughlin, 1989), paralleling that of *R. woodsii* subsp. *manca* except for the Mogollon Rim component. In some regions, as in central and western Colorado and southeastern Utah, *R. nutkana* subsp. *melina* is frequent and may be found growing near or with *R. woodsii* subsp. *manca*, but the subspecies also occurs at higher elevations beyond the others' range. Hybrids are possible but not expected even in mixed or nearby populations; this is because *R. nutkana* subsp. *melina* is hexaploid, while *R. woodsii* subsp. *manca* is diploid and because flowering of *R. nutkana* subsp. *melina* occurs before that of *R. woodsii* subsp. *manca*, although there can be an overlap of anthesis. No intermediate tetraploid hybrid has been found (Bruneau, Ertter & Lewis, unpublished data).

Selected exsiccatae. U.S.A. **Colorado:** Archuleta Co., S San Juan Wilderness Area, N side Fish Lake trail, 2870 m, 19 July 2003, *L. Lundquist & G. Rink L216a* (MO, SJNM); Garfield Co., to Little Trappers' Lake, 2870 m, 3 Aug. 1933, *L. A. Hanna 1512* (MO); Gunnison Co., Alpine rd. at milepost 15.7, 11.1 mi. S of U.S. hwy. 50, ca. 3080 m, 11 July 2006, *J. L. Reveal 8777* (with *C. R. Broome*) (MARY, MO, NY); vic. of Mt. Carbon, 3000 m, 29 June 1910, *W. W. Eggleston 5779* (US); La Plata Co., La Plata Canyon, beyond old La Plata City, 2875 m, 20 July 2005, *W. H. Lewis & M. Elvin-Lewis 21000* (MO, MT, UC); Mesa Co., 5 mi. NW of Mesa Lake, ca. 2440 m, 17 Aug. 1955, *F. J. Hermann 12184* (US); Mineral Co., FS rd. 634, 1.3 mi. E of jct. with FS rd. 633, 2575 m, 21 Aug. 2002, *K. Heil & W. Mietty 20197* (SJNM); Montezuma Co., Mancos Canyon, 2 mi. above Aspen Guard station, 20 July 2005, 2985 m, *W. H. Lewis & M. Elvin-Lewis 15992* (MO, MT, UC); Montrose Co., Uncomprahgre Plateau, head of Red Canyon, 2865 m, 7 Aug. 2004, *B. Ertter 18464 et al.* (MO, UC); Rio Grande Co., FS rd. 667, ca. 7 mi. SW of McCormick cabin, 3170 m, 24 July 1996, *K. Heil 10397* (SJNM); San Miguel Co., near Trout Lake, 3000 m, 16 Aug. 1924, *E. B. Payson & L. B. Payson 4141* (GH, MO, UC). **Idaho:** Cassia Co., Hereford Ranger Station, 2440 m, 7 June 1927, *W. P. Cottam 3022* (F). **New Mexico:** Taos Co., Carson Forest, Apache Peak & Spring, 3000 m, 23 Aug. 1923, *W. W. Eggleston 19251* (US). **Utah:** Grand Co., Uinta Basin, 10 mi. E of Sunnyside near Willow Springs, 2910 m, 11 July 1935, *E. H. Graham 9580* (A, MO); San Juan Co., Abajo Mtns., N slope, 2590–3355 m, 1–2 July 1930, *G. J. Goodman & C. L. Hitchcock 1424* (MO).

2. Rosa woodsii Lindley, Ros. Monogr. 21. 1820. TYPE: U.S.A. (Nebraska–Iowa to Montana, not Missouri): near Missouri River, seeds grown by J. Sabine, Royal Hort. Society; "cultiv. HHS 1825" on herb. collection of plant designated "type" five years following publication of species (neotype, designated here, CGE).

KEY TO THE SUBSPECIES OF *ROSA WOODSII* IN CENTRAL AND WESTERN NORTH AMERICA

1a. Shrubs most frequently short, typically less than 1 m, infrequently to 2 m; fertile branches densely prickly of various sizes, rarely few or unarmed; terminal leaflets obovate, fewer ovate or elliptic; flowers 1 to 3, rarely more; prairies and plains of central North America extending into the Rocky Mtns. and nearby Southwest.
  2a. Prickles straight, rarely curved; sepals commonly eglandular on outer surfaces or margins; rare or absent in highest elevations of Rocky Mtns. and outlying peaks and ridges . . . . . .subsp. *woodsii*
  2b. Prickles curved, rarely straight; sepals commonly stipitate-glandular on outer surfaces or margins; endemic to high elevations of Rocky Mtns. and outlying peaks and ridges . . . . . subsp. *manca*
1b. Shrubs most frequently tall, 1–3(–5) m; flowering branches unarmed or with straight or curved prickles; terminal leaflets ovate to elliptic, fewer obovate; flowers 1 or 2 or corymbose and then 3 to 10(to 15); western North America including the far Southwest.
  3a. Prickles typically strongly curved, mostly short and stout, infrastipular paired; flowers 1 or 2 most common (to 6); sepals stipitate-glandular on outer surfaces or margins, infrequently eglandular; low mountains and elevated riparian areas, primarily in northern Arizona and adjacent New Mexico, Colorado, Utah, and Nevada, with possible disjuncts as far north as southern Idaho . . . . subsp. *arizonica*
  3b. Prickles straight or occasionally somewhat curved, absent or few to dense; flowers few, 3 most common or numerous (to 15); sepals eglandular or infrequently stipitate-glandular; intermontane between Cascade and Rocky Mtns. of British Columbia to southern Great

Basin and mountains of Mojave Desert, and east to Rocky Mtns.

4a. Stems openly branching; prickles absent or sometimes scattered and/or infrastipular singly or paired, predominately straight; flowers commonly corymbose, 3 to 10(to 15); intermontane between Cascade and Rocky Mtns., common in Great Basin . . . . . subsp. *ultramontana*

4b. Stems densely branching; prickles stout and often long, straight or curved, sometimes infrastipular and often dense and varying in size internodally; SW Great Basin, Mojave Desert and adjacent mountains . . . . . .subsp. *gratissima*

2a. Rosa woodsii Lindley subsp. **woodsii**. Figure 2A–D.

Rosa demareei E. J. Palmer, J. Arnold Arbor. 10: 36. 1929. Syn. nov. TYPE: U.S.A. Texas: Jeff Davis Co., Davis Mtns., Mt. Livermore, 4 June 1928, *E. J. Palmer* (with *D. Demaree*) *34351* (holotype, A 32568; isotypes, BH, F 678153, PH 690968, US 1439498).

Rosa deserta Lunell, Amer. Midl. Naturalist 2: 156. 1912. TYPE: U.S.A. North Dakota: Benson Co., Pleasant Lake, 2 July (fl) & 14 Aug. (fr) 1911, *J. Lunell 592* (lectotype, designated here, 14 Aug. 1911 [fr], MIN 245877; isotypes, MO 1011606 [fr], NY 415925 [fr] & 415926 [fr], PH 697763 [fr]).

Rosa fendleri Crépin, Bull. Soc. Roy. Bot. Belgique 15: 91. 1876. *Rosa woodsii* var. *fendleri* (Crépin) Rydberg in Bessey, Fl. Nebr., Rosales 21: 22. 1895. TYPE: U.S.A. New Mexico: vic. of Las Vegas, Aug. 1847, *A. Fendler 210* (lectotype, designated here, BR; isotypes, BM, CGE, GH 32572 & 32574, K, MO 1949548, P, UC 711153).

Rosa fimbriatula Greene, Leafl. Bot. Observ. Crit. 2: 135. 1912. TYPE: U.S.A. Montana: rt. bank of Missouri River, 15 mi. below Round Butte, 1 Sep. 188x, *L. F. Ward s.n.* (holotype, US 46847; isotype, US 46848).

Rosa foliolosa [var.] *leiocarpa* Torrey in Frémont, Rep. 89. 1843. TYPE: U.S.A. Nebraska: Lower Platte River, *J. C. Frémont s.n.* (holotype, NY 415838).

Rosa hypoleuca Wooton & Standley, Contr. U.S. Natl. Herb. 16: 131. 1913. TYPE: U.S.A. New Mexico: Sierra Co., S end of Black Range, near Kingston, 1 June 1904, 1980 m, *O. B. Metcalfe 940* (holotype, US 497843; isotype, NY 415845).

Rosa macounii Greene, Pittonia 4: 10. 1899. TYPE: Canada. Saskatchewan (as "Assiniboia"): Milk River, 7 July 1895, *J. Macoun s.n.*, GSC 10533 (lectotype, designated here, CAN 100023; isotypes, GH 32585, NDG 23690).

Rosa maximiliani Nees in Wied-Neuwied, Reise N. Amer. 2: 434. 1841. TYPE: U.S.A. South Dakota to NE Montana: vic. of Missouri River, *A. P. Maximilian s.n.* (lectotype, designated here, BR [Carl von Martius herb. 1444]).

Rosa naiadum Lunell, Amer. Midl. Naturalist 3: 139. 1913. TYPE: U.S.A. North Dakota: Ward Co., Minot, along Souris River, 1 July 1909, *J. Lunell 596* (holotype, MIN 245872).

Rosa poetica Lunell, Amer. Midl. Naturalist. 3: 138. 1913. TYPE: U.S.A. North Dakota: Burleigh Co., banks of Missouri River, near Bismarck, 23 Aug. 1913, *J. Lunell 593* (holotype, MIN 245883).

Rosa sandbergii Greene, Leafl. Bot. Observ. Crit. 2: 137. 1911. TYPE: U.S.A. Montana: Dawson Co., Colgate, near Glendive, 6 Sep. 1892, *J. H. Sandberg, D. T. Macdougal & A. A. Heller 1009* (holotype, US 239926; isotype, NY 415882).

Rosa standleyi Rydberg, N. Amer. Fl. 22: 527. 1918. TYPE: U.S.A. New Mexico: San Miguel Co., near Pecos, 18 Aug. 1908, 2045 m, *P. C. Standley 5043* (holotype, NY 4298991; isotypes, GH 32620, MO 123830).

Rosa subnuda Lunell, Amer. Midl. Naturalist 2: 153. 1912. TYPE: U.S.A. North Dakota: Benson Co., Butte, 25 June (fl) & 28 Aug. 1911 [fr], *J. Lunell 596* (lectotype, designated here, 25 June 1911 [fl], MIN 245873; isotypes, MIN 245874 [fl], RM 156259 [fl]).

Rosa terrens Lunell, Amer. Midl. Naturalist 2: 151. 1912. *Rosa woodsii* var. *terrens* (Lunell) Breitung, Canad. Field-Naturalist 68: 82. 1954. Syn. nov. TYPE: U.S.A. North Dakota: Benson Co., Pleasant Lake, 14 Aug. 1911, *J. Lunell 594* (holotype, MIN 245875 [sheet 1 of 2]; isotype, MIN 245875 [sheet 2 of 2]).

Fruiting material (14 Aug. 1911) of *Rosa deserta* is designated lectotype as it is diagnostic and isolectotypes are widely available; syntype (2 July 1911 [fl]) is at MIN 245858.

In his protologue, Crépin described *Rosa fendleri* based on a collection at B, which was destroyed during World War II. Later in the protologue, he discussed finding *Fendler 210* at both BM and K, the former described with some uncertainty due to variation from the Berlin material, while the K collection was not discussed further, presumably because it was more similar to the original B collection. It is diagnostic, and so the K specimen is chosen lectotype.

Rosa foliolosa [var.] *leiocarpa* (smooth hip) is not an eglandular hipped form of *R. foliolosa* Nuttall, which is not known from or near Nebraska. Rather, Torrey mistakenly described a new variety of *R. woodsii* that is typical of the species. In their protologue three years earlier, Torrey and Gray (1840: 460) extended the range of *R. foliolosa*, with a query, to eastern Florida, which is *R. palustris* Marshall. Clearly Nuttall, but not Torrey or Gray, had a correct concept of his new species, which is known only from south-central U.S.A.

In his protologue, Greene cited three syntypes of *Rosa macounii*, two collected in Assiniboia (Saskatchewan) and a third in Wyoming. Based on Rydberg's (1918: 525) selection of the type locality as Saskatchewan, and since these two were collected by Macoun and are diagnostic, the Milk River collection is selected lectotype where isolectotypes are known at both GH and NDG. Syntypes are from: CANADA. Saskatchewan: Moose Jaw, 13 Aug. 1895, *J. Macoun s.n.*, GSC 10532 (CAN 100025); and U.S.A. Wyoming: Laramie Co., near Cheyenne, 24 June 1896, *E. L. Greene s.n.* (NDG 23692). Martin and Hutchins (1980: 928) reduced *R. macounii* to a variety of *R. woodsii*, but as the basionym was not provided it

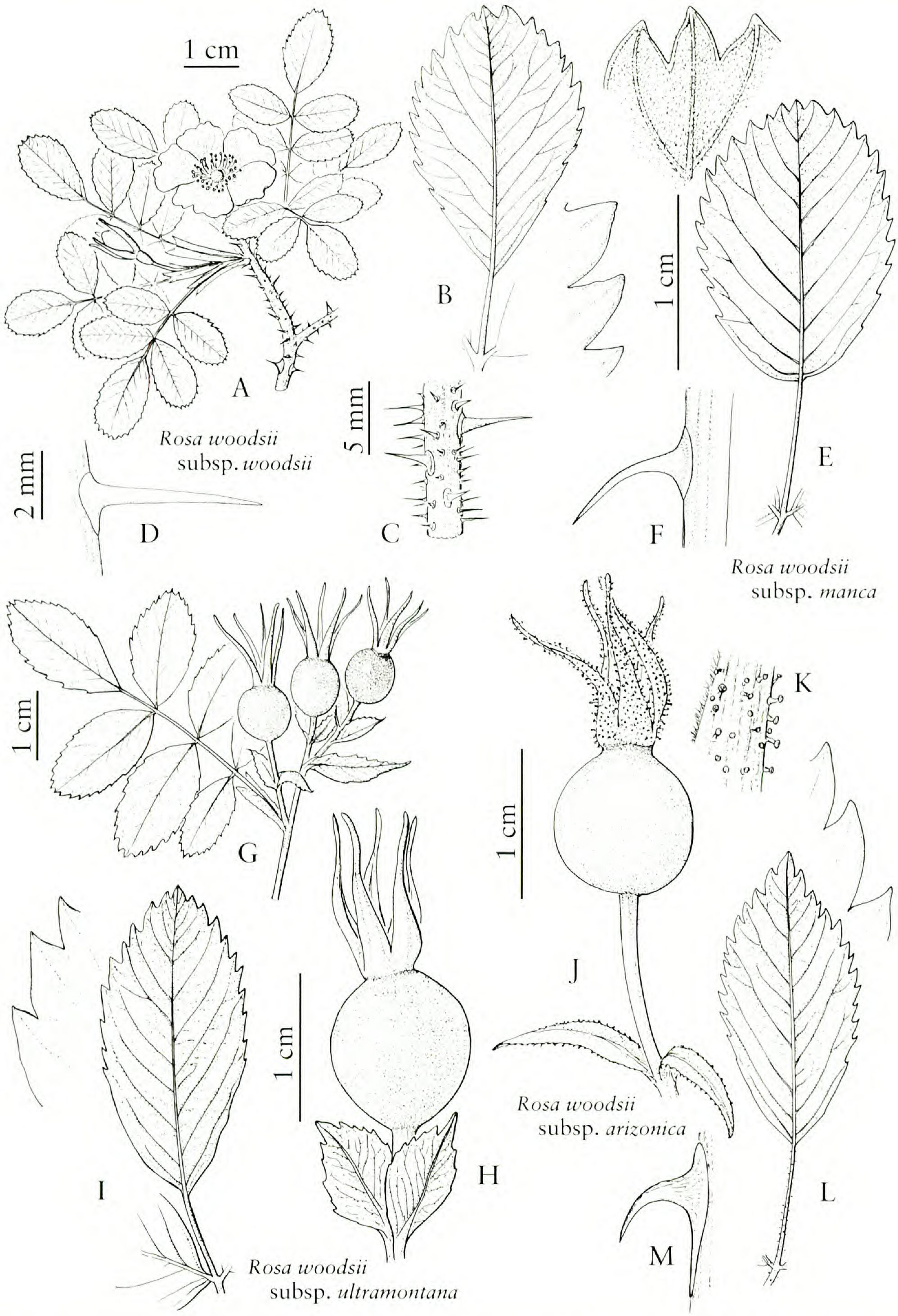

Figure 2. *Rosa woodsii* Lindley subspecies. A–D. Subspecies *woodsii*. —A. Flowering branch. —B. Terminal leaflet with serrations. —C. Varying prickles of branch. —D. Straight prickle. E–F. Subspecies *manca* (Greene) W. H. Lewis & Ertter. —E. Terminal leaflet with serrations. —F. Curved prickle single or paired. G–I. Subspecies *ultramontana* (S. Watson) R. L. Taylor & MacBryde. —G. Fruiting branch. —H. Hip with sepals and bracts. —I. Terminal leaflet with serrations. J–M. Subspecies *arizonica* (Rydberg) W. H. Lewis & Ertter —J. Hip with sepals. —K. Enlarged sepal section showing stipitate glands. —L. Leaflet with serrations. —M. Hooked short prickle single or double. A–D drawn from *Croutch 4* (MO); E–F drawn from *Heil & Mietty 19938* (SJNM); G–I drawn from *Garrett 4099* (MO); J–M drawn from *Ertter 18487* (MO); all by J. Myers.

remains an invalid name. Similarly, another variety of theirs, *R. woodsia* var. *hypoleuca* (Wooten & Standley) W. C. Martin & C. R. Hutchins (1980: 928), is also invalid because it lacks a cited basionym.

As both the Maximilian and Martius herbaria are well represented in Crépin's herbarium at BR, the specimen there identified as *Rosa maximiliani* is chosen lectotype, as no other original collection has been located.

Rosa subnuda flowering material, *Lunell 594* (25 June 1911 [fl]), is selected lectotype because the syntype (14 Aug. 1911 [fr]) has not been found.

Rosa woodsii subsp. *woodsii* occurs in the prairies and high plains, often in woodland or riparian habitats, of central Canada and the United States from east-central Alaska, southern Yukon, and the Northwest Territory, south to northeastern British Columbia, and east to Manitoba; it is rare to western Ontario and Wisconsin, south to western Iowa, northwestern Oklahoma, western Texas, and west to New Mexico and eastern Arizona, and also extends into the passes of the Rocky Mountains from Montana to Colorado.

2b. Rosa woodsii Lindley subsp. **ultramontana** (S. Watson) R. L. Taylor & MacBryde, Canad. J. Bot. 56: 189. 1978. Basionym: *Rosa californica* Chamisso & Schlechtendal var. *ultramontana* S. Watson in W. H. Brewer & S. Watson, Fl. Calif. 1: 187. 1876. *Rosa ultramontana* (S. Watson) A. Heller, Muhlenbergia 1: 107. 1904. *Rosa woodsii* var. *ultramontana* (S. Watson) Jepson, Fl. Calif. 2: 210. 1936. *Rosa pisocarpa* var. *ultramontana* (S. Watson) M. Peck (as "*transmontana*"), Man. Higher Pl. Oregon 404. 1941. TYPE: U.S.A. Nevada: Elko Co., East Humboldt Mtns. (= Ruby Mtns.), 2134 m (7000 ft.), July 1868, *S. Watson 349* (lectotype, designated here, GH 244258). Figure 2G–I.

Rosa chrysocarpa Rydberg, Bull. Torrey Bot. Club 44: 74. 1917. TYPE: U.S.A. Utah: San Juan Co., Allen Cañon, SW of Abajo Mtn., 1800–2000 m, 30–31 July 1911, *P. A. Rydberg & A. O. Garrett 9302* (holotype, NY 415920; isotype, US 765208).

Rosa grosseserrata E. E. Nelson, Bot. Gaz. 30: 119. 1900 (as "*grosse-serrata*"). TYPE: U.S.A. Wyoming: Madison River, Yellowstone Park, 30 Aug. 1899, *A. Nelson & E. W. Nelson 6787* (holotype, RM 20282; isotypes, MO 1798950, NY 415843, P, RM 156216).

Rosa lapwaiensis H. St. John, Fl. Southeast Wash. & Idaho, 208. 1937. TYPE: U.S.A. Idaho: Nez Perce Co., Spalding, flat by Lapwai Creek, 27 May 1928, *H. St. John, W. W. Eggleston, C. English & G. N. Jones 9538* (holotype, WS 64725; isotypes, GH 32584, MIN 332733, NY 415848, RM 143193, UC 544891, US 1654700, WS 64381 & 64382).

Rosa pyrifera Rydberg, Fl. Rocky Mts. 445, 1062. 1917. TYPE: U.S.A. Idaho: Bonner Co., shores of Lake Pend d'Oreille, near Lake View, 7 Aug. 1892, *J. H. Sandberg, D. T. MacDougal & A. A. Heller 871* (holotype, NY 415877; isotypes, K, MIN 258201, US 239145).

Rosa rotundata Rydberg, Bull. Torrey Bot. Club 44: 76. 1917. Syn. nov. TYPE: U.S.A. Nevada: Washoe Co., mtns. W of Franktown, 1737 m, 2 July 1912, *A. A. Heller 10520* (holotype, NY 335708; isotypes, DS 12495, GH 32615 & 61910, US 509790).

Rosa salictorum Rydberg, Bull. Torrey Bot. Club 44: 77. 1917. TYPE: U.S.A. Nevada: Nevada Co., Gold Creek, 1920 m, 25 July 1912, *A. Nelson & J. F. Macbride 2113* [often only *J. F. Macbride*] (holotype, NY 415880; isotypes, DS 252551, GH 32617, MO 1035641, NY 415881, POM 190661, RM 76160 & 132364, UC 500427).

The original description of *Rosa californica* var. *ultramontana* did not cite collections and noted only that the variety is "on the eastern side of the Sierra Nevada, ranging to the Rocky Mountains." The inclusion of "*R. blanda*, Watson, Bot. King Exp. 91, and others" in his protologue, however, is an indirect reference to King Expedition 349, which is the number cited for *R. blanda* in the botanical report of the U.S. Geological Exploration of the Fortieth Parallel (Watson, 1871). As noted by Tiehm (1985), expedition numbers in this report were assigned to all collections believed to be the same taxon, often from multiple localities, and were primarily distributed among GH, NY, US, and YU. Although Tiehm recommends that taxa described by Watson be lectotypified on specimens at US, since this is where Watson was based while preparing the King Expedition report, the GH specimen of *Watson 349* collected by Watson in East Humboldt Mountains is selected as lectotype, because Watson was at Harvard University while preparing the *Botany of California*. The designated lectotype is an excellent representative specimen, with both flowers and developing fruit, and is annotated as *R. californica* var. *ultramontana* in Watson's hand. Syntypes of *Watson 349* include Unionville [Valley] (Pershing Co., NV), June 1868, *S. Watson* (NY 415919, US 65169, YU not seen), Humboldt Mountains (Elko Co., NV), Sept. 1868, *S. Watson* (NY 415918), and Truckee Valley (Washoe Co., NV), July 1867, *W. W. Bailey* (GH 244259, US 65170). The Bailey collection at GH is mounted on the same sheet with the lectotype, along with a collection by C. L. Anderson from Carson City, Nevada Territory, 1863 (GH 244263). The Anderson collection, and possibly numerous others, also qualifies as a syntype, given Watson's blanket reference to "and others" in his protologue.

Rosa woodsii subsp. *ultramontana* occurs from central British Columbia east to Idaho, western Wyoming, and probably also western Montana, south to California east of the Cascade Mountains, and Utah, Nevada, and infrequently as disjunct populations in Arizona and New Mexico. It is the commonest rose of this largely intermontane region that includes the Great Basin in western North America.

2c. Rosa woodsii Lindley subsp. **arizonica** (Rydberg) W. H. Lewis & Ertter, comb. et stat. nov. Basionym: *Rosa arizonica* Rydberg, N. Amer. Fl. 22: 516. 1918. TYPE: U.S.A. Arizona: Coconino Co., vic. of Flagstaff, 2134 m, 15 June 1898, *D. T. Macdougal 110* (holotype, NY 415909; isotypes, F 69856, GH 32554, NY 415910, RM 31869, UC 136507, US 334205). Figure 2J–M.

Rosa adenosepala Wooton & Standley, Contr. U.S. Natl. Herb. 16: 131. 1913. Syn. nov. TYPE: U.S.A. New Mexico: San Miguel Co., along Pecos River, 8 mi. E of Glorietta, 1950 m, 9 June 1897, *A. A. Heller & E. G. Heller 3674* (holotype, US 306499; isotypes, DAO 704029, MIN 130468, MO 1951202, P).

Rosa bakeri Rydberg, Fl. Colorado 191. 1906, nom. illeg., non *Rosa bakeri* A. Déséglise, J. Bot. 2: 267. 1864. Syn. nov. TYPE: U.S.A. Colorado: La Plata Co., Dix Post Office, 1898, *C. F. Baker, F. S. Earle & S. M. Tracy 474* (lectotype, designated here, MO 123806; isotypes, MO 1951244, NY).

Rosa granulifera Rydberg, N. Amer. Fl. 22: 517. 1918. Syn. nov. *Rosa arizonica* var. *granulifera* (Rydberg) Kearney & Peebles, J. Wash. Acad. Sci. 29: 481. 1939. TYPE: U.S.A. Arizona: Navajo Co., W of Holbrook, 10 July 1896, *M. Zuck s.n.* (holotype, NY 415841; isotypes, MO 123818, NY 415840, US 348991).

Rosa neomexicana Cockerell, Entomol. News 12: 38. 1901. Syn. nov. TYPE: U.S.A. New Mexico: Otero Co., Sacramento Mtns., Cloudcroft, grown and collected at Mesilla, New Mexico, 4 May 1894, *T. D. A. Cockerell s.n.* (lectotype, designated here, US 404918; isotype, NY 425856).

Rosa puberulenta Rydberg, Fl. Rocky Mts. 443, 1062. 1917. Syn. nov. TYPE: U.S.A. Utah: San Juan Co., Montezuma Canyon, E of Monticello, 2000 m, 13 Aug. 1911, *P. A. Rydberg & A. O. Garrett 9705* (holotype, NY 415876; isotype, US 765307).

Martin and Hutchins (1980: 930) reduced *Rosa arizonica* to a variety of *R. woodsii*, but as the basionym was not provided, it remains an invalid name. An additional two varieties of theirs, *R. woodsii* var. *adenosepala* (Wooten & Standley) W. C. Martin & C. R. Hutchins (1980: 929) and *R. arizonica* var. *granulifera* (Rydberg) W. C. Martin & C. R. Hutchins (1980: 928), are also invalid, lacking provision of basionym.

Tiehm (1989) provided evidence to support the valid publication of *Rosa bakeri* and also *R. pandorana* Greene (see *R. nutkana* subsp. *melina*) found in Rydberg's *Flora of Colorado* (1906: 191). Rydberg provided no descriptions for these, nor for 26 additional new names, but since he used excellent keys to separate species, Tiehm believed that they were distinguishable and so satisfied the provisions of Article 32.2. However, Rydberg gave no collectors for localities he listed; fortunately, locality descriptions of *Rosa* are sufficiently unique to associate collectors with localities using material at NY, MO, US, and other herbaria. He provided *R. bakeri* with four syntypes. Tiehm suggested that holotypes or lectotypes be selected from collections he listed in his paper, although he clearly stated that he was not designating lectotypes. The latter is fortunate with regard to *R. bakeri*, for Tiehm's choice of *Baker s.n.* (U.S.A. Colorado: Routt Co., Four-miles Hill, 2 July 1896) would have been inappropriate since Rydberg (1904: 561) had already used this collection as holotype of *R. oreophila* (see *R. nutkana* subsp. *melina*). The lectotype selected above (*Baker et al. 474*) is appropriate diagnostic material that clearly delineates between *R. nutkana* and *R. woodsii*, which Rydberg often confused, and since the specific epithet honors Baker as collector, it seems appropriate to select a syntype collected by him. Unfortunately, the *R. oreophila* sheet at NY (415860) is annotated with two holotype labels, one for *R. oreophila*, which the specimen clearly represents (= *R. nutkana* subsp. *melina*), and the other for *R. bakeri*, which it certainly does not. In this instance, the lectotype is chosen from one of two sheets of *Baker et al. 474* at MO (123806), where no ambiguity of identity or typification exists and where Rydberg wrote and initialed "*Rosa bakeri*" on the sheet and later stamped by his writing "OK Dr. Rydberg Sep. 1911."

With regard to lectotypification of *Rosa neomexicana*, Cockerell did not select a type from several collections he and/or E. O. Wooton gathered at Cloudcroft, New Mexico, or from those then cultivated at Mesilla, New Mexico, nor did he indicate a herbarium of deposit, so a lectotype appropriate to his diagnosis was chosen at US with an isolectotype at NY. Martin and Hutchins (1980: 929) reduced *R. neomexicana* to a variety of *R. woodsii*, but as the basionym was not provided, it remains an invalid name.

Rosa woodsii subsp. *arizonica* occurs in Arizona, western Colorado, southwestern Nevada, New Mexico, and Utah at elevations ranging from ca. 1400 to 2200 m, with a possible disjunction in southern Idaho. It is most frequent in Arizona and southern Utah and as such is associated with the southern Colorado Plateau Floristic Element (McLaughlin, 1989) in North America.

Selected exsiccatae. U.S.A. **Arizona:** Apache Co., White Mtns., 10 mi. S of Black River, 1830 m, 22 June 1930, *G. J. Goodman & C. L. Hitchcock 1296* (MO); Cochise Co., Chiricahua Mtns., Stephens' ranch, 1830 m, Oct. 1906, *J. C. Blumer 1240* (US); Coconino Co., Oak Creek Canyon, 9 mi. N of Sedona, 1620 m, 1 July 1992, *J. S. Miller et al. 7746* (MO); rd. to Inner Basin on E side of San Francisco Mtns., 17 Aug. 2004, *B. Ertter et al. 18484* (MO, UC); Mohave Co., Wild Cow Spring, Hualapai Mtns. SE of Kingman, 13 Aug. 2004, *B. Ertter 18489 (with L. Woodruff)* (MO, UC); Yavapai Co., Prescott, 14 Aug. 1932, *G. J. Harrison, T. H. Kearney & R. H. Peebles 8885* (POM, UC). **Nevada:** Clark Co., Charleston Park, Charleston Mtns., 8 Aug. 1937, *I. W. Clokey 7788* (POM, UC); Hidden Forest, Sheep Mtns., 10 June 1940, *A. M. Alexander & L. Kellogg 1701* (UC). **New Mexico:** Grant Co., Mangus Springs, along streams, 30 May 1881, H. H. Rusby 129 1/2 (MO); San Juan Co., San Juan River, Jewett Valley Tract, 1710 m, 18 June 1997, *T. Reeves & L. Reeves 9418* (SJNM). **Utah:** Duchesne Co., 4 mi. N of Mountain Home, 2135 m, 13 June 1934, *B. F. Harrison & E. Larson 7592* (MO); Kane Co., W of Coral Pink Dunes, vic. of Pine Spring, ca. 1700 m, 29 May 1992, *S. L. Welsh 25005* (MO); San Juan Co., Montezuma Canyon, ca. 13 air mi. SSE of Monticello, ca. 1720 m, 19 Aug. 2004, *B. Ertter 18480 (with L. Woodruff)* (MO, UC); Navajo Nation, ca. 2 mi. SE of Blanding, 1720 m, 21 June 2004, *K. Heil et al. 24062* (MO, SJNM); Washington Co., SE of Enterprise Reservoir, 1780 m, 18 June 1998, *L. Higgins 19725* (MO).

2d. Rosa woodsii Lindley subsp. **manca** (Greene) W. H. Lewis & Ertter, comb. et stat. nov. Basionym: *Rosa manca* Greene, Pittonia 4: 11. 1899. TYPE: U.S.A. Colorado: Montezuma Co., Upper West Mancos Cañon, 2750 m, 3 July 1898, *C. F. Baker, F. S. Earle & S. M. Tracy 313* (holotype, NDG 23545; isotypes, F 76117 & 356377, GH 32587, K, MO 123823, NO, NY 415852 & 415853, RM 13646 & 156323, US 337232). Figure 2E–F.

Rosa woodsii subsp. *manca* occurs in the high mountains of Arizona, Colorado, New Mexico, Utah, and Wyoming (rare) at elevations ca. 2350–3300+ m within the Southern Rocky Mountain–Mogollon Floristic Element (McLaughlin, 1986, 1989) in North America. It is not the *R. manca* sensu Erlanson (1934: 230), which is described as a hexaploid ecotype species of *R. nutkana* (= subsp. *melina*).

Selected exsiccatae. U.S.A. **Arizona:** Apache Co., Luka-Chukai Mtns. 2800 m, 4 July 1936, *G. J. Goodman & L. B. Payson 2926* (MO); Coconino Co., Kendrick Peak along trail 22, 3050 m, 5 Aug. 1983, *J. Ricketson 570* (MO). **Colorado:** Archuleta Co., along Piedra River trail, 2990 m, 30 June 1999, *K. Heil et al. 13435* (SJNM); Gunnison Co., Gothic, N of Judd Falls along Copper Creek, 2990–3050 m, 26 July 1977, *L. J. Dorr 602* (MO); Mineral Co., 0.3 mi. from jct. of hwy. 160 & Tucker Ponds rd., 2830 m, 21 July 2005, *W. H. Lewis & M. Elvin-Lewis 21005* (MO, UC); Montrose Co., Uncompahgre Plateau, 19 air mi. SW of Montrose, 2965 m, 7 Aug. 2004, *B. Ertter et al. 18463* (MO, UC); Ouray Co., SE of Ouray, 2300–2600 m, 7 Sep. 1901, *L. M. Underwood & A. D. Selby 63* (NY); Summit Co., Lake Dillon, near jct. of hwys. 170 & 6, 2800 m, 9 July 1985, *W. H. Lewis 9828* (MO), *9829* (MO). **New Mexico:** McKinley Co., Navajo Nation, ca. 12.5 mi. turning SE of Whiskey Lake rd., 2685 m, 15 Sep. 2004, *K. Heil & W. Mietty 24937* (MO, SJNM); San Miguel Co., Sangre de Cristo Mtns., valley of Gallinas River, 2590–2745 m, 11–17 Aug. 1945, *C. L. Lundell & A. A. Lundell 14478* (MO); Taos Co., Carson Natl. Forest, ca. 8 mi. NW of Mora, 2750 m, 1 July 1998, *H. H. Schmidt et al. 2727* (MO); Forestry rd. 537 from Red River to Cabresto Canyon, 2440–2775 m, 17 June 2006, *H. van der Werff 21523* (MO). **Utah:** San Juan Co., N slope of Abajo Mtns., 2590–3355 m, 1–2 July 1930, *G. J. Goodman & C. L. Hitchcock 1424* (F); Navajo Nation, Navajo Mtn., just E of War God Spring, 2608 m, 7 July 2001, *S. L. O'Kane Jr. et al. 5797* (SJNM); Uinta Co., Uinta Basin, Taylor Mtn., Davis Hollow, 2655 m, 7 Sep. 1931, *E. H. Graham 7492* (MO); Washington Co., Markagunt Plateau, ca. 1.6 km N of Kolob Reservoir, 2500 m, 7 July 1984, *N. H. Holmgren & P. K. Holmgren 10591* (NY, UT). **Wyoming:** Sweetwater Co., S side of Cedar Mtns., 2440 m, 7 July 1981, *R. W. Lichvar 4574* (NY).

2e. Rosa woodsii Lindley subsp. **gratissima** (Greene) W. H. Lewis & Ertter, stat. nov. Basionym: *Rosa gratissima* Greene, Fl. Francisc. 1: 73. 1891. *Rosa pisocarpa* var. *gratissima* (Greene) Jepson, Man. Fl. Pl. Calif. 499. 1925. *Rosa woodsii* var. *gratissima* (Greene) D. Cole, Amer. Midl. Naturalist 55: 223. 1956. Syn. nov. TYPE: U.S.A. California: Kern Co., near Tehachapi, mtns. by wet meadows, 24 June 1889, *E. L. Greene s.n.* (holotype, NDG 23620; isotype, NY 415842).

Rosa woodsii subsp. *gratissima* occurs in springs and along streams in the mountains in and surrounding the Mojave Desert and southern Great Basin, from the east side of the Sierra Nevada in Mono County, California, east to Eureka County in central Nevada, and south to the Nevada Test Site in Nye County and the north slope of the San Bernardino Mountains, San Gabriel Mountains, and Mount Pinos in southern California. This is also the characteristic subspecies in the southern Sierra Nevada from Fresno County southward, and populations occur in the White Mountains on the California–Nevada border and the Panamint Mountains west of Death Valley.

Selected exsiccatae. U.S.A. **California:** Fresno Co., Doris Lake, 1 mi. N of High Sierra Pack Station at Mono Hot Springs on S Fork San Joaquin River N of Kaiser Ridge, 27 Aug. 1959, *C. H. Quibell 3389* (RSA, UC); Inyo Co., Thorndykes Springs, Wildrose Canyon, Panamint Mtns., 12 July 1947, *J. C. Roos 2837* (RSA); Big Pine Creek at foot of trail to Big Pine Lakes, 26 July 1934, *R. S. Ferris 9009* (DS, UC); Kern Co., 3 mi. E of monolith, [s.d.], *M. Zigmond 713* (POM); Los Angeles Co., Prairie Fork of San Gabriel River,

23 Aug. 1917, *I. M. Johnston 1704* (RSA, UC); Mono Co., 2 mi. SE of Hardy Station, 11 Sep. 1936, *W. A. Peterson 593* (UC); San Bernardino Co., 2 mi. along Mill Creek Rd. and 2N10 from Coldbrook Campgound, San Bernardino Mtns., 15 July 1976, *R. F. Thorne, L. DeBuhr, C. Davidson & C. W. Tilforth 47723* (RSA, UC); Tulare Co., S branch of Monache Creek, near S fork of Kern River, 24 July 1950, *P. A. Munz 15349* (RSA); Ventura Co., Seymour Meadows, Mt. Pinos, 11 July 1905, *H. M. Hall 6624* (UC). **Nevada:** Clark Co., Indian Springs, base of NE slope of Spring Mtns., 1860 m, 1 June 1970, *J. Beatley & J. L. Reveal 10822* (MO); Esmeralda Co., 1 mi. E of Lida, 9 Aug. 1928, *C. B. Wolf 3218* (RSA); Trail Canyon, White Mtns., 1 July 1931, *V. Duran 3089* (POM, UC); Eureka Co., vic. of the Willows, ca. 34 mi. W of Eureka, 5 July 1937, *F. S. Goodner & W H. Henning 572* (POM); Lincoln Co., Bald Mtn. Spring, Timpahute Range, 2000 m, 2 July 1968, *J. L. Reveal & J. C. Beatley 1451* (MO); Lander Co., Smith's Creek Canyon, 44 mi. W of Austin, 10 July 1937, *F. S. Goodner & W. H. Henning 655* (MO); Nye Co., along wash below Cliff Spring, Belted Range, Nevada Test Site, 8 June 1969, *J. Beatley & H. Kaaz 8890* (RSA); Thirsty Canyon, Rose Creek, 1830 m, 27 July 1967, *J. Beatley & W. H. Rhoads 4547* (MO).

2e1. Rosa woodsii Lindley var. **glabrata** (Parish) D. Cole, Amer. Midl. Naturalist 55: 223. 1956, non *Rosa glabrata* P. Kitaibel in A. Kanitz, Linnaea 32: 588. 1863. *Rosa californica* Chamisso & Schlechtendal var. *glabrata* Parish, Erythea 6: 88. 1898. *Rosa mohavensis* Parish, Bull. Soc. S. Calif. 1: 87. 1902. *Rosa woodsii* var. *mohavensis* (Parish) Jepson, Fl. Calif. 2: 210. 1936, nom. illeg., earlier name available at rank. TYPE: U.S.A. California: San Bernardino Co., desert side of San Bernardino Mtns., Cushenberry Spring, 1200 m, 1 June 1892, *S. B. Parish 2481* (holotype, DS; isotype, GH).

Localized clusters of glabrous populations on the north foot of the San Bernardino Mountains represent the variety *glabrata* within *Rosa woodsii* subsp. *gratissima*.

Selected exsiccatae. U.S.A. **California:** San Bernardino Co., Box "S" Springs, Mojave Desert, 28 Apr. 1926, *H. L. Mason 3090* (GH, UC); 2 mi. W of Cushenberry Springs, 975 m, 9 Oct. 1937, *P. A. Munz & F. Youngberg 14962* (MO).

Acknowledgments. The authors thank James L. Reveal and C. Rose Broome for herbarium and living collections from western Colorado, Henk van der Werff for collections from northern New Mexico, and Memory Elvin-Lewis and Lindsay Woodruff for support in the field. Special appreciation goes to the WS group (Larry Hufford, Joy Mastroguiseppe, and Joshua Brokaw), RM (Ronald Hartman), GH (Emily Wood and Melinda Peters), and US (Rusty Russell) for providing digital images of types, and the directors, curators, and managers of herbaria at A, ASC, BM, BR, CAN, CAS, CGE, CIC, CU, DAO, DS, E, GH, JEPS, K, LE, MIN, MO, MT, NDG, NO, NY, P, PH, POM, PR, RSA, SASK, SJNM, SPR, UC, US, UTC, WTU, and YU, who organized loans, made digital image databases available, made research visits to use their collections possible, and assisted in other ways. Support to Barbara Ertter from the Lawrence R. Heckard Endowment Fund of the Jepson Herbarium is gratefully acknowledged. We are indebted to staffs of the Jeanette Goldfarb Plant Growth Facility, Department of Biology, Washington University, and the University of California Botanical Garden for assistance with living collections. Our reviewers, Roy Gereau and Robert J. O'Kennon, and editor Victoria Hollowell provided most helpful guidance and suggestions for improving the manuscript. We also thank John Myers at MO for his fine line drawings of both species.

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Gastrodia wuyishanensis, a New Species of Orchidaceae from Fujian, China

Li Daming

College of Landscape Architecture, Beijing Forestry University, Beijing 100083, People's Republic of China. lidaming81@hotmail.com

Liu Chudian

Wuyishan National Nature Reserve of Fujian, Wuyishan 354135, People's Republic of China

Abstract. *Gastrodia wuyishanensis* Da M. Li & C. D. Liu (Orchidaceae) from Wuyishan National Nature Reserve in Fujian, China, is described and illustrated. This new species is similar in habit to *G. menghaiensis* Z. H. Tsi & S. C. Chen, from which it differs by having a rhombic-ovate lip that lacks a long claw at the base and two calli on the upper surface as found in *G. menghaiensis*.

Key words: China, *Gastrodia*, IUCN Red List, Orchidaceae.

Gastrodia R. Brown, a leafless orchid genus of ca. 20 species, is found in Asia and Oceania. Altogether, 13 species have been recognized in China (Chen, 1999). Of these, all but *G. elata* Blume and *G. javanica* Endlicher are endemic to either Taiwan or Yunnan. The new species described here was first collected by the second author in August 2000 in a dense forest in the Wuyishan area in Fujian province. However, the specimen was rather poor, and we failed to identify it by its floral characters. Four years later, two plants of this entity were collected again from the same area, one in blossom and the other with immature fruit. This close examination showed that it is an undescribed species, quite distinct from other *Gastrodia* known to us. It somewhat resembles *G. menghaiensis* Z. H. Tsi & S. C. Chen in habit, but differs by its rhombic-ovate lip lacking a long claw at its base and two calli on its upper surface as found in *G. menghaiensis*. The new species is also somewhat similar to *G. gracilis* Blume in habit, but the new species differs by having a brownish hairy rhizome, undulate sepal lobes, and subsessile lip.

Gastrodia wuyishanensis Da M. Li & C. D. Liu, sp. nov. TYPE: China. Fujian: Jianyang Co., Wuyishan, in shaded, dense forest, 1280 m, 23 Aug. 2004, *C. D. Liu 4823* (holotype, PE). Figure 1.

Habitu *Gastrodiae menghaiensi* Z. H. Tsi & S. C. Chen subsimilis, sed labello rhombeo-ovato, nec longo-unguiculato basin versus nec calloso superficie bene differt.

Mycoheterotrophic plants; rhizome tuberous, cylindric-ellipsoid, 1.5–2 cm, 6–8 mm thick, with 3 or 4 slightly contracted nodes, brownish hairy throughout the surface, near the base with several fleshy roots 3–20 cm. Stem erect, 10–20 cm, 2–3 mm diam., gray brownish or gray greenish, 3- or 4-noded below the middle, sheathed; sheaths cylindric, 4–13 mm. Inflorescence 2.5–7 cm, loosely 5- to 8-flowered; bracts broadly ovate, 2–3 mm, acute at apex, brownish, falling after anthesis; pedicellate ovary greenish white, 3–7 mm. Flowers slightly nodding, somewhat cylindric-campanulate or broadly cylindric, 7–11 mm; sepals and petals united forming a perianth tube, with free lobes at apex; perianth tube 6–9 mm, 4–5 mm diam., very slightly broader toward the apex; sepal lobes suberect, triangular-semiorbicular or nearly semiorbicular, 1.5–2 × 2.5–3.5 mm, slightly crisped-undulate or undulate margined; petal lobes much smaller, nearly semiorbicular, 0.7–0.9 × 0.5–0.6 mm, slightly undulate margined; lip white, rhombic-ovate, 2–3 × 1.5–2 mm, connate at base to the short column foot, lacking conspicuous appendage on the upper surface; column slightly arching, 4–5 mm, with a narrow white wing on either side; wings dilated toward the apex; stigma at the ventral base of the column; pollinia 2, granular-farinaceous, composed of many separable masses, without caudicle and viscidium; immature fruit ca. 5 mm.

Phenology. Flowering in August and September.

Distribution and habitat. *Gastrodia wuyishanensis* is found in Wuyishan National Nature Reserve, Jianyang County, Fujian province, China, at 1280–1350 m, in shaded, dense forests.

IUCN Red List category. The new species is threatened due to the destruction of forests. This is

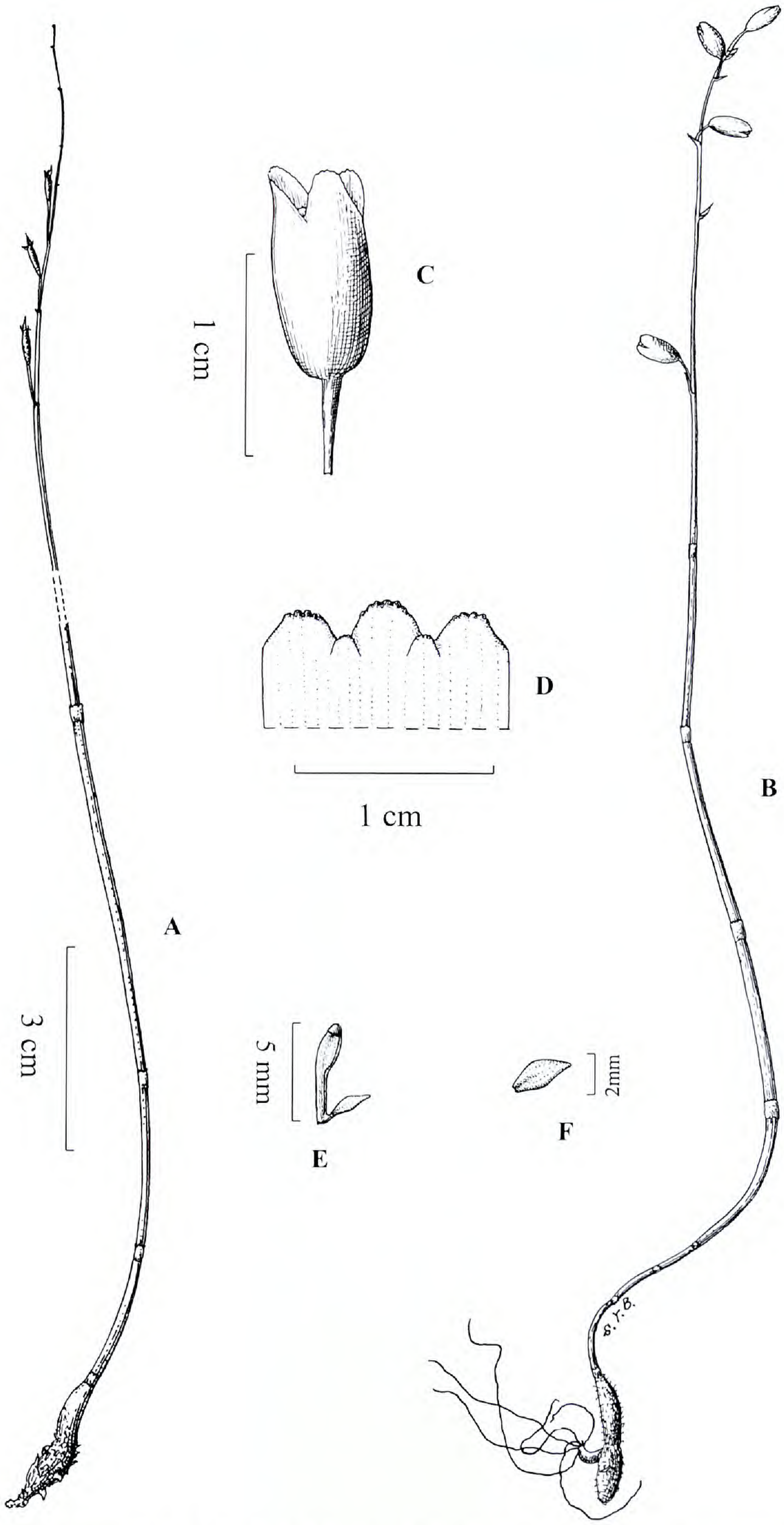

Figure 1. *Gastrodia wuyishanensis* Da M. Li & C. D. Liu. —A. Plant with immature fruit. —B. Plant with inflorescence. —C. Flower. —D. Opened perianth (upper part), showing sepal lobes and petal lobes. —E. Lateral view of column and lip. —F. Lip. Scale bar common to A and B. Drawn from the holotype, *Liu 4823* (PE).

a very rare species, which we saw only twice in the field, although we do fieldwork there year after year. Its endangered status should be evaluated as CR (Critically Endangered), according to the IUCN Red List (IUCN, 2001).

Paratype. CHINA. **Fujian:** Jianyang Co., Wuyishan, in shaded place in dense forest, 1350 m, 23 Aug. 2000, *C. D. Liu 0823* (PE).

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A New Species of *Cyrtandra* (Gesneriaceae) from Hawai'i, Hawaiian Islands

David H. Lorence and Steven Perlman
National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Hawai'i 96741, U.S.A.
lorence@ntbg.org

ABSTRACT. A new Hawaiian species of the Pacific genus *Cyrtandra* J. R. Forster & G. Forster, *C. wagneri* Lorence & Perlman, is described from the island of Hawai'i. It is unique in its combination of opposite leaves, cauligerous 12- to 25-flowered cymose inflorescences, deeply divided calyx that is actinomorphic, symmetrical in bud, and persistent in fruit, and calyx lobes that are lanceolate to linear-oblong, green, and internally puberulent distally. Due to its restricted distribution, small population size, and vulnerability to threats from feral animals, weeds, and stochastic events, it is considered to be critically endangered (CR) based on IUCN Red List criteria.

Key words: *Cyrtandra*, Gesneriaceae, Hawai'i, IUCN Red List.

Cyrtandra J. R. Forster & G. Forster is the largest genus of Gesneriaceae, represented by at least 600 species centered in southeastern Asia and the Malesian region (Cronk et al., 2005). Primarily restricted to wet, evergreen, and rainforest regions, *Cyrtandra* species are typically very sensitive to habitat disturbance. The genus ranges from northern Queensland, Australia, eastward through Melanesia, Micronesia, and Polynesia to the Hawaiian Islands, where 58 species occur. *Cyrtandra* is very complex in the Hawaiian Islands, with 514 names for the 58 species currently recognized by Wagner (1999) and Wagner et al. (2006). All Hawaiian species are endemic, and many are restricted to a single island or even a single locality (Wagner, 1999; Wagner et al., 2001). Wagner (1999) assigned the Hawaiian species to six sections, although current evidence suggests that the Hawaiian lineage is the result of a single colonization event (Cronk et al., 2005). More than 80 natural hybrid combinations have been identified, but these generally occur as isolated individuals where two or more species grow sympatrically (Wagner, 1999). Intensive collecting efforts by the National Tropical Botanical Garden (NTBG) collectors have revealed a number of new species, rediscoveries, and range extensions throughout the Hawaiian Islands in a diversity of vascular plant families. The following new species was collected by Steven Perlman in the Laupahoehoe Natural Area Reserve (NAR) on the Big Island of Hawai'i.

Cyrtandra wagneri Lorence & Perlman, sp. nov. TYPE: Hawaiian Islands (U.S.A.). Hawai'i: North Hilo District, Laupahoehoe NAR, banks of Kaiwilahilahi stream, both sides of stream, 2700–2800 ft. [823–853 m], 19°56.416′N, 155°16.057′W, 20 June 2003, *S. P. Perlman, L. Perry & R. Warshauer 17591* (holotype, PTBG; isotypes, BISH, MO, US). Figure 1.

Species a congeneribus hawaiiensibus inflorescentiis caulinis cymosis 12- ad 25-floris, calyce florialum regulari profunde fisso, lobis calycinis erectis lanceolatis vel linearioblongis aequalibus 12–14 mm longis, 2–3 mm latis, intra apicem versus pubescentibus differt.

Shrub or treelet to 3 m tall, main stem solitary or sparsely branched, to 2.5 cm diam., most parts golden- to dark-brown villosulous-hirtellous with spreading to antrorsely curved septate hairs 0.4–0.9 mm, leafy stems 5–10 mm diam., internodes 2–3 cm; leaves of a pair equal or subequal, symmetrical to somewhat asymmetrical, petiole 2.5–10 cm, densely villosulous-hirtellous, blade elliptic to oblong-elliptic, 20–41 × 8–18.5 cm, adaxially densely strigillose-hirtellous, abaxially moderately to densely velutinous-hirtellous with crinkled hairs, pubescence denser on veins and margin, venation prominent and raised, margin serrulate, teeth with hair tufts. Inflorescences cauligerous, borne near ground level or up to 2 m above, dichasial, at first erect, becoming pendulous with age, 4–6 × 4–9 cm, 2- to 3-branched cymes of 12 to 25 flowers, densely brown villosulous-hirtellous, primary axes 1–2.5 cm, secondary axes 1–2 cm, usually ending in 2- to 4-flowered cymules, bracts narrowly ovate to oblong, 4–9 × 1.5–2 mm; flowers on robust pedicels 10–15 mm long; calyx actinomorphic, green when fresh, 13–15 mm, cleft to 7/8 its length or nearly to the base, the lobes erect, lanceolate to linear-oblong, 12–14 × 2–3 mm, apex acute, externally densely golden brown strigulose-hirtellous, internally strigulose in distal 1/2–2/3; corolla white, tube subcylindrical, flaring somewhat

Figure 1. *Cyrtandra wagneri* Lorence & Perlman. —a. Habit (based on photo of *Lorence et al. 8906*). —b. Leaf. —c. Inflorescence with flowers at anthesis and fruits in various stages. —d. Flower, frontal view. —e. Corolla, opened for internal view. —f. Corolla, opened for external view. —g. Flower with two calyx lobes and corolla removed. —h. Fruit, side view. —i. Fruit, longitudinal section. a, b based on *Lorence et al. 8906*; c, h, i based on *Lorence et al. 8907*; d–g based on *Perlman 17675*. Scale bars = 1 cm.

at mouth, slightly curved near middle, (12)15–22 mm, externally strigulose-hirtellous with pale brown hairs, glabrous in basal 1/3, internally glabrous, upper 3 lobes suborbicular to broadly rhombic-ovate, (4)5–9 × 6–12 mm, lower 2 lobes 5–8 × 6–7 mm, lobes externally strigulose-hirtellous or glabrous near margins, internally puberulent at least basally and at throat with capitate glandular hairs; anther 2–2.5 mm, ovoid, filament 1.5–2 mm, slightly coiled; nectary 1 mm deep, ovary 5 mm, ovoid, glabrous or with a few

scattered hairs, style 8–10 mm, pilosulous distally, stigma 3 mm, obconical-flabellate, 4-lobed; berries white, ovoid to ovoid-ellipsoid, 13–16 × 7–8 mm, seeds pale brown, ellipsoid, 0.3 mm.

Distribution and habitat. This distinctive new species is known only from Hawai'i Island, North Hilo District, in the Laupahoehoe Natural Area Reserve along the Kilau stream and nearby Kaiwilahilahi stream (Fig. 2). It is restricted to steep (up to ca. 45°) slopes of stream banks at 823–869 m elevation, rooting in rocky brown clay soil substrate, in moderate to dense shade of wet forest dominated by *Acacia koa* A. Gray and *Metrosideros polymorpha* Gaudichaud. Other native associates include *Pipturus albidus* (Hooker & Arnott) A. Gray, *Freycinetia arborea* Gaudichaud, *Cheirodendron trigynum* (Gaudichaud) A. Heller, *Cibotium glaucum* (Smith) Hooker & Arnott, *Coprosma* J. R. Forster & G. Forster sp., *Kadua axillaris* (Wawra) W. L. Wagner & Lorence, *Myrsine lessertiana* A. DC., *Perrottetia sandwicensis* A. Gray, *Rubus hawaiensis* A. Gray, *Clermontia parviflora* Gaudichaud ex A. Gray, *Touchardia latifolia* Gaudichaud, *Antidesma platyphyllum* H. Mann var. *platyphyllum*, *Platydesma remyi* (Sherff) O. Degener, I. Degener, Sherff & B. C. Stone, and *Cyrtandra tintinnabula* Rock. Various terrestrial ferns, including *Diplazium sandwichianum* (C. Presl) Diels, are abundant in the understory, and *Peperomia* species and bryophytes prevail in the ground flora.

IUCN Red List category. At the Kilau stream locality a subpopulation of approximately 150 plants (ca. 50 adults and 100 juveniles) was observed by the authors in 2002. The number of individuals at the Kaiwilahilahi stream subpopulation was estimated to be only about 10 sterile plants in 1989. The Kilau and Kaiwilahilahi subpopulations are separated by 1 km of degraded wet forest. Threats include damage by feral pigs, which may root and disturb the soil of the steep slopes where *Cyrtandra wagneri* grows. Additional threats include predation of tender stems and foliage by rats and slugs. Stochastic events include torrential rain that may erode stream banks and wash away plants growing there. Weeds include strawberry guava (*Psidium cattleianum* Sabine) and Koster's Curse (*Clidemia hirta* (L.) D. Don var. *hirta*), which are both abundant and aggressively invasive in the area, as well as the daisy fleabane (*Erigeron karvinskianus* DC.), an herb that forms dense, smothering mats. Two other highly invasive weeds, *Hedychium gardnerianum* Ker Gawler and *Setaria palmifolia* (J. König) Stapf, were recently observed to be gaining a strong foothold just downstream of the Kilau stream population (K. Wood, pers. comm., Jan. 2007). All these factors threaten the long-term survival of this new *Cyrtandra* species. Due to its restricted distribution, the small size of the two known subpopulations, and threats from feral animals, weeds, and stochastic events, it is concluded that *C. wagneri* is in need of inclusion in the IUCN Red List.

Following the IUCN Red List criteria (IUCN, 2001), *Cyrtandra wagneri* is estimated to fall within the CR (Critically Endangered) category, and is therefore considered to be facing an extremely high risk of extinction in the wild. The formal evaluation can be summarized by the following IUCN hierarchical alphanumeric numbering system found in the IUCN Red List Categories and Criteria Version 3.1 (IUCN, 2001): B1ab(iii) + 2ab(iii); D.

Phenology. This new species was collected in flower in July and August and in fruit in August. It grows sympatrically with *Cyrtandra tintinnabula*, a federally listed endangered species also endemic to the island of Hawai'i.

Affinities. *Cyrtandra wagneri* is a distinctive species characterized by its relatively large opposite leaves, cauligerous 12- to 25-flowered cymose inflorescences, deeply divided actinomorphic calyx that is symmetrical in bud, persistent in fruit, and cleft nearly to the base with erect, green, lanceolate to linear-oblong lobes that are internally strigillose distally. These characters would place it in section *Macrosepalae* C. B. Clarke or section *Chaetocalyces* Hillebrand (sensu Wagner, 1999), groups with non-foliaceous bracts and green calyces with narrow lobes cleft nearly to the base. However, this new species does not correspond with any of the currently described Hawaiian *Cyrtandra* species in these (or any other) sections, and furthermore the inflorescences of *C. wagneri* are consistently cauligerous on old stems, not axillary or ramigerous.

Unpublished molecular phylogenetic evidence using a combined analysis of ITS, ETS, and *psbA-trnH* regions places *Cyrtandra wagneri* as sister to *C. tintinnabula* with > 95% support in a clade with other Hawaiian species (John R. Clark, pers. comm., Nov. 2006). Although the two species are closely related based on molecular evidence, morphological differences between them are considerable. *Cyrtandra tintinnabula* differs by its leaves with petioles 35%–70% as long as the blade, broadly ovate to broadly elliptic lamina with rounded base, densely villous indument of reddish brown, bulbous-tipped hairs, consistently axillary inflorescences of 2- to 4-flowered umbelliform cymes with peduncles 10–18 mm long, pedicels 5–15 mm long subtended by a pair of broadly ovate or cordate bracts 9–15 mm long, campanulate calyces cleft only 1/4–1/3 their length with broadly triangular, reflexed lobes, and externally glandular-

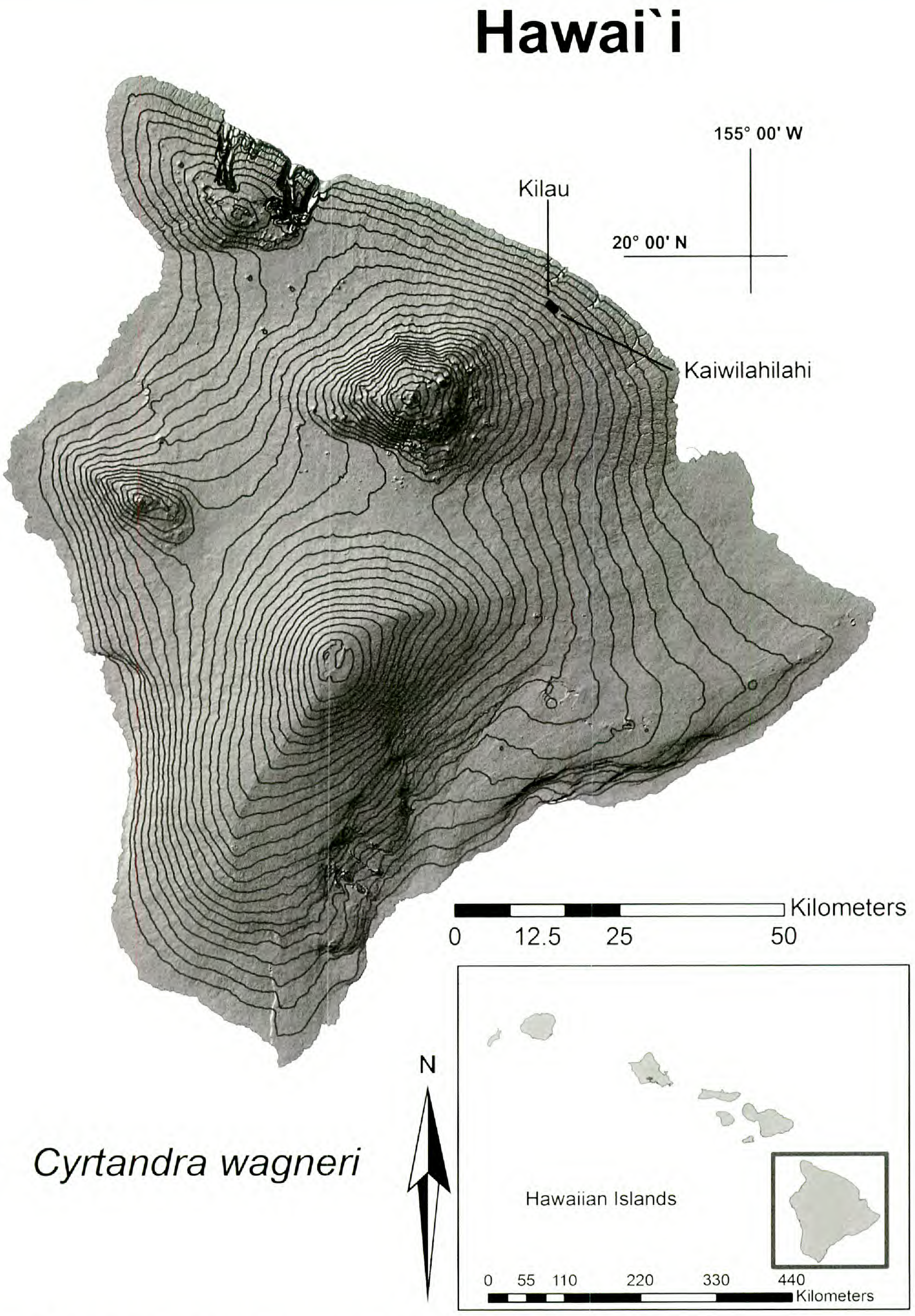

Figure 2. Location of the two known subpopulations of *Cyrtandra wagneri* on the island of Hawai'i.

villous corollas with a shorter tube 10–12 mm long and smaller lobes 2.5–3 mm long. Furthermore, these two species flower approximately concurrently and may occasionally form hybrids: at least one hybrid individual was collected in the area (*Perlman 17677*, PTBG). One possible explanation for the sympatric existence of these two closely related species may be exploitation of different pollinators, as corolla tubes are 10–12 mm long in *C. tintinnabula* and (12)15–22 mm long in *C. wagneri*, but pollination of

Cyrtandra is completely unknown and in great need of study. Another possible explanation for the molecular results is that this rare species may now be restricted to a small area in sympatry with *C. tintinnabula* and may have been strongly influenced by occasional hybridization followed by introgression. Considerable morphological differentiation may occur in certain genera, such as *Astragalus* L., *Penstemon* Schmidel, and *Mentzelia* L. in North America, without an apparent molecular signal (John R. Clark, pers. comm., Nov. 2006).

Etymology. We are pleased to name this new species for our colleague Warren L. Wagner, Curator of Pacific Botany at the Smithsonian Institution, in recognition of his extensive contributions to our knowledge of the Hawaiian flora and systematic studies of the genus *Cyrtandra*.

Paratypes. HAWAIIAN ISLANDS (U.S.A.). **Hawai'i:** North Hilo District, Laupahoehoe Natural Area Reserve, SW of Laupahoehoe, Kilau stream gulch, 2850 ft. [869 m], 14 Aug. 2002, *Lorence et al. 8906* (PTBG, US), *8907* (BISH, PTBG, NY, US); Kilau stream, east bank, 838 m, 2 Jan. 2003, *Perlman & Perry 18326* (PTBG, US, WU), 11 Apr. 2003, *Perlman & Perry 18557* (PTBG, US); Laupahoehoe NAR, banks of Kaiwilahilahi stream, both sides of stream, 2700–2800 ft. [823–853 m], 20 June 2003, *Perlman et al. 17591* (BISH, MO, PTBG, US), 2700 ft. [823 m], 1 Aug. 2003, *Perlman et al. 17672* (PTBG, US, WU), *Perlman 17675* (PTBG, US, WU), 2800 ft. [853 m], 1 Aug. 2003, *Perlman et al. 17673* (PTBG), *Perlman et al. 17678* (PTBG); Laupahoehoe NAR, Kaiwilahilahi stream banks, transect 9, station 11 to 12, 2520 ft. [768 m], 19 Nov 1988 (st), *Perlman et al. 10645* (PTBG, US).

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Lectotypification of *Miconia*, *Octomeris*, and *Staphidium* (Melastomataceae) Names Described by Naudin

Claire V. Martin

The Ohio State University, Department of Evolution, Ecology and Organismal Biology, 314 Aronoff Laboratory, 318 W. 12th Ave., Columbus, Ohio 43210, U.S.A.; New York Botanical Garden, 200th St. & Southern Blvd., Bronx, New York 10458, U.S.A. clairemiconia@gmail.com

Georges Cremers

IRD, National Museum of Natural History, Systematics and Evolution Department, UMS 0602, Case postale 39, 16 rue Buffon, F-75231 Paris cedex 05, France. gecremers@wanadoo.fr

Renato Goldenberg

Universidade Federal do Paraná, Departamento de Botânica, C.P. 19031, CEP 81531-970, Curitiba, Paraná, Brazil. rgolden@ufpr.br

Abstract. Thirty Neotropical *Miconia* Ruiz & Pavón taxa described by Naudin and available in BR or P have been lectotypified: *M. alternans* Naudin, *M. amygdalina* Naudin, *M. anceps* Naudin, *M. axilliflora* Naudin, *M. brachystyla* Naudin, *M. bracteolaris* Naudin, *M. claussenii* Naudin, *M. fothergilla* (DC.) Naudin var. *gracilipes* Naudin, *M. impetiolaris* (Swartz) D. Don var. *pandurifolia* Naudin, *M. lucida* Naudin, *M. melanodendron* Naudin, *M. molybdea* Naudin, *M. myriocarpa* Naudin, *M. myrtillifolia* Naudin, *M. obovalis* Naudin, *M. otodesma* Naudin, *M. plukenetii* Naudin, *M. proteoides* A. Saint-Hilaire & Naudin, *M. rhamnoidea* Naudin, *M. rhytidophylla* Naudin, *M. riedelii* Naudin, *M. rivoeriae* Naudin, *M. stellifera* Naudin, *M. stipularis* Naudin, *M. tentaculifera* Naudin, *M. tococoides* Naudin, *M. versicolor* Naudin, *M. verticilliflora* Steudel ex Naudin, *Octomeris macrodon* Naudin, and *Staphidium triste* Richard ex Naudin.

Resumo. Neste trabalho foram lectotipificados trinta táxons neotropicais pertencentes a *Miconia* Ruiz & Pavón, descritos por Naudin e depositados em BR ou P: *M. alternans* Naudin, *M. amygdalina* Naudin, *M. anceps* Naudin, *M. axilliflora* Naudin, *M. brachystyla* Naudin, *M. bracteolaris* Naudin, *M. claussenii* Naudin, *M. fothergilla* (DC.) Naudin var. *gracilipes* Naudin, *M. impetiolaris* (Swartz) D. Don var. *pandurifolia* Naudin, *M. lucida* Naudin, *M. melanodendron* Naudin, *M. molybdea* Naudin, *M. myriocarpa* Naudin, *M. myrtillifolia* Naudin, *M. obovalis* Naudin, *M. otodesma* Naudin, *M. plukenetii* Naudin, *M. proteoides* A. Saint-Hilaire & Naudin, *M. rhamnoidea* Naudin, *M. rhytidophylla* Naudin, *M. riedelii* Naudin, *M. rivoeriae* Naudin, *M. stellifera* Naudin, *M. stipularis* Naudin, *M. tentaculifera* Naudin, *M. tococoides* Naudin, *M. versicolor* Naudin, *M. verticilliflora* Steudel ex Naudin, *Octomeris macrodon* Naudin e *Staphidium triste* Richard ex Naudin.

Key words: Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Jamaica, lectotypification, Martinique, Melastomataceae, Mexico, *Miconia*, Naudin, Neotropics, *Octomeris*, Panama, *Staphidium*, Surinam, Venezuela.

Charles V. Naudin (1815–1899), a French botanist, worked at the Muséum National d'Histoire Naturelle in Paris from 1845 to 1869 (Dayrat, 2003). His works were based mainly on hybridization (Naudin, 1861, 1863, 1875), evolution (Naudin, 1874), and taxonomy. His taxonomic studies covered several plant families, such as the Cucurbitaceae (Naudin, 1852, 1856, 1859) and *Eucalyptus* L'Héritier de Brutelle (Naudin, 1891), but his most important contribution was on the Melastomataceae (Naudin, 1849–1853). Naudin was a pioneer on this family, preceded by A. Bonpland, D. Don, A. P. de Candolle (Renner, 1993), and G. Raddi (Goldenberg & Baldini, 2003). Many of the specialists that followed Naudin, such as Triana (1871) and Cogniaux (1891), would base their works on his. Naudin described more than 700 new species of Melastomataceae in 13 articles, all published through the *Annales des Sciences Naturelles (Troisiéme Série, Botanique)* and later reprinted in a consolidated form (Naudin, 1849–1853). The Miconieae were treated mostly in one article published by Naudin in 1851 (Naudin, 1849–1853), where he recognized 201 species of *Miconia*

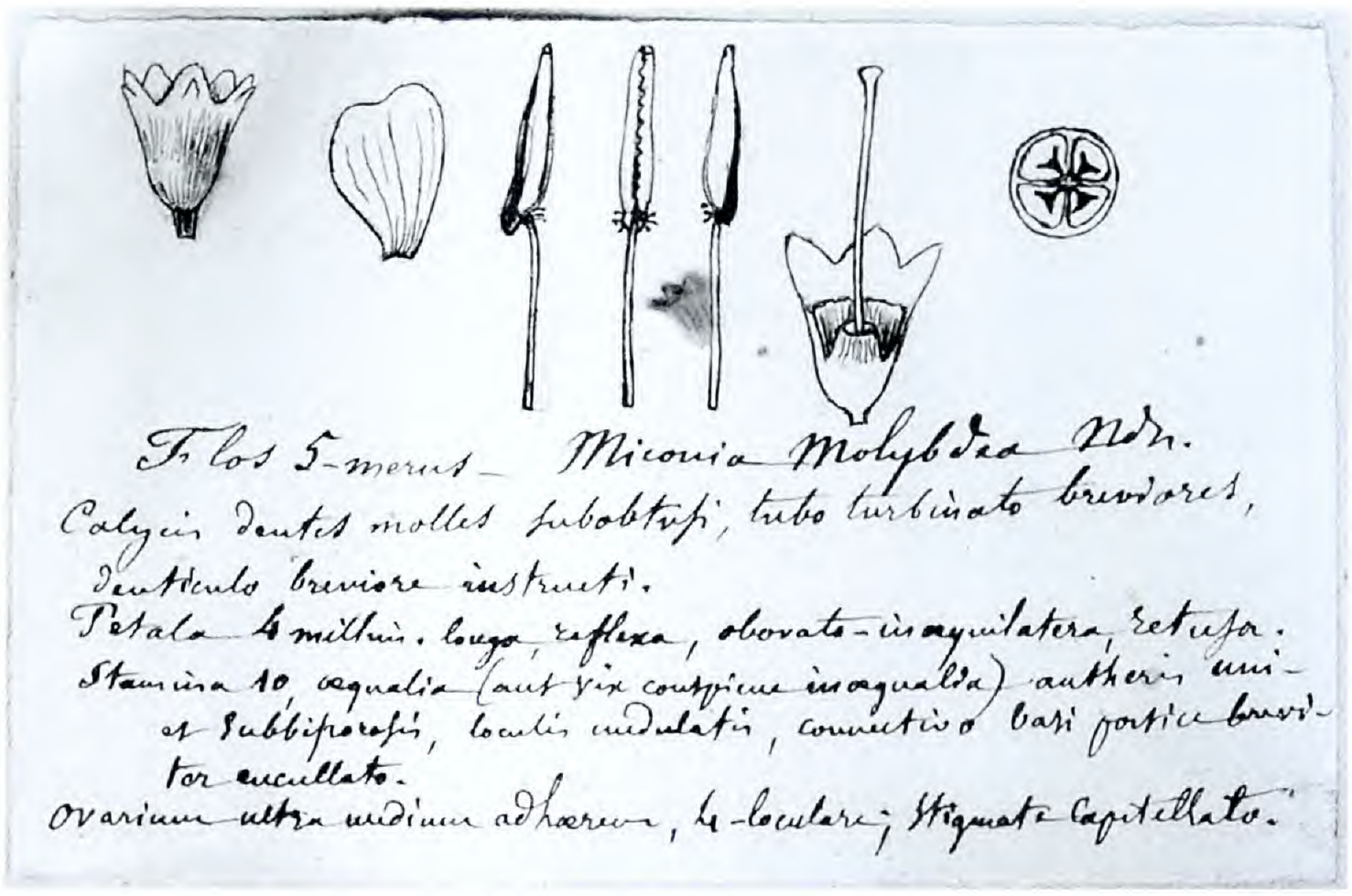
Flos 5-merus — Miconia Molybdea Ndn.
Calycis dentes molles subobtusi, tubo turbinato breviores, denticulo breviore instructi.
Petala 4 millim. longa, reflexa, obovato-inaequilatera, retusa.
Stamina 10, aequalia (aut vix conspicue inaequalia) antheris uniporosis, loculis undulatis, connectivo basi postice brevi-tor excultato.
Ovarium ultra medium adhaerens, 4-loculare; stigmate capitellato.

Figure 1. Drawing and description from Naudin's herbarium specimen for *Miconia molybdea* (*de Castelnau 40*, P lectotype).

Ruiz & Pavón (180 of them new) and transferred an additional 102 taxa to the genus. Among Naudin's 180 new species of *Miconia*, 149 were based on single collections, these being then regarded as holotypes, and 31 species were based on syntypes.

Naudin worked almost exclusively on the material available at P (G. Aymonin, pers. comm.) and made detailed drawings on the label of one specimen for each species he described (Fig. 1). These drawings oriented us in our specimen choice for the lectotype. His handwriting is shown in Figure 2.

Miconia is the largest genus in the Melastomataceae, containing almost one quarter of the species diversity in the family (1051 following Goldenberg, 2000). All species of *Miconia* are native to the New World (Renner, 1993), but some have been introduced in other regions, becoming weeds in Hawaii (Conant, 1998) and Tahiti (Fosberg & Sachet, 1981). This genus has been recognized as paraphyletic by recent authors (Judd & Skean, 1991; Clausing & Renner, 2001), with several lineages deriving from within it that have been traditionally treated as distinct genera, like *Tococa* Aublet, *Conostegia* D. Don, *Tetrazygia* Richard ex DC., *Leandra* Raddi, and others (Michelangeli et al., 2004). The actual state of taxonomic knowledge of the group, in the traditional point of view, is very poor, since Cogniaux's last revision dates from the 19th century (Cogniaux, 1891). In this revision, he recognized 518 species of *Miconia*, which are nearly half of the ones recognized today. The genus name *Miconia* is a nomen conservandum. The work of Kuntze (1891) on the synonymization of *Miconia* to *Acinodendron* Rafinesque is not accepted by any recent Melastomataceae taxonomists.

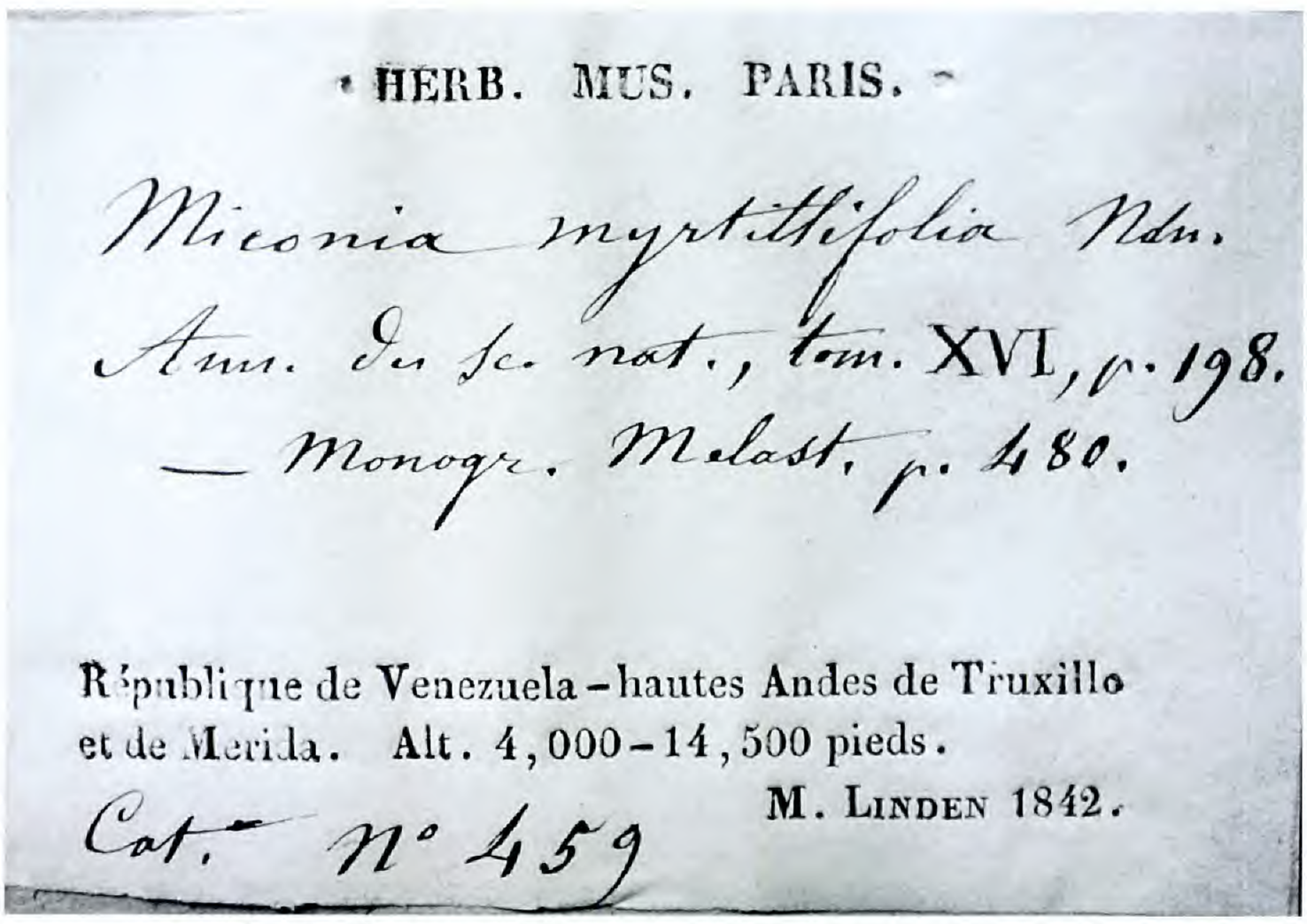
HERB. MUS. PARIS.
Miconia myrtillifolia Ndn.
Ann. des sc. nat., tom. XVI, p. 198.
— Monogr. Melast. p. 480.
République de Venezuela – hautes Andes de Truxillo et de Merida. Alt. 4,000–14,500 pieds.
M. Linden 1842.
Cat. n° 459

Figure 2. Handwriting on label from Naudin's herbarium specimen for *Miconia myrtillifolia* (*J. J. Linden 459*, P lectotype).

Due to this lack of knowledge, there are gaps in information about types that we are attempting to resolve through the databasing of type information in a project called "Index of the Type Specimens of *Miconia*." Information about the types of *Melastoma* L. (as basionym of some *Miconia* species) described by Raddi (Goldenberg & Baldini, 2003) has already been provided, and those described by Cogniaux and other authors are being prepared. In this work, we made all lectotypifications of the *Miconia* species described by Naudin based on syntypes. In all cases, we chose the richer or more complete specimens as lectotype, and of those specimens, those bearing Naudin's drawings and description were our first choice.

New Lectotypifications

1. Miconia alternans Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 161 [in adnotationes p. 720]. 1850 [1851]. *Acinodendron alternans* (Naudin) Kuntze, Revis. Gen. Pl. 2: 950. 1891, as "*Acinodendrum*." TYPE: French Guiana. Cayenne: *J. Martin s.n.* (lectotype, designated here, P; duplicates, BR, P [4]).

Selected specimen. FRENCH GUIANA. **Cayenne:** *F. M. Leprieur s.n.* (syntypes, BM, BR, P [2]).

2. Miconia amygdalina Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 141. 1850 [1851]. TYPE: Brazil. Rio de Janeiro: *C. Gaudichaud 723* (lectotype, designated here, P; duplicates, P [2]).

This taxon was previously referred to *Miconia fasciculata* Gardner, fide Cogniaux (1891).

Selected specimen. BRAZIL. **Rio de Janeiro:** *C. Gaudichaud 735* (syntypes, P [3]).

3. Miconia anceps Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 150. 1850 [1851]. TYPE: Colombia. Tolima: Mariquita, *A. J. Bonpland s.n.* (lectotype, designated here, P; duplicates, P [4]).

This taxon was previously referred to *Miconia trinervia* (Swartz) D. Don ex Loudon, fide Wurdack (1973), as well as Wurdack et al. (1993).

Selected specimen. PERU. **Huanuco:** Cutervo, *E. F. Poeppig 1733* (syntype, P).

4. Miconia axilliflora Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 179. 1850 [1851]. *Acinodendron axilliflorum* (Naudin) Kuntze, Revis. Gen. Pl. 2: 949. 1891, as "*Acinodendrum*." TYPE: French Guiana. 1842, *Mélinon 86* (lectotype, designated here, P; duplicates, P [3]).

This taxon was previously referred to *Miconia acuminata* (Steudel) Naudin, fide Cogniaux (1891), as well as Wurdack et al. (1993).

Selected specimens. FRENCH GUIANA. **Cayenne:** Near Cayenne, *F. M. Leprieur s.n.* (syntypes, P [2]); *J. Martin s.n.* (syntype, P); 1842, *Mélinon 175* (syntype, P).

5. Miconia brachystyla Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 230. 1850 [1851]. TYPE: Mexico. Near Oaxaca, 1840, *H. G. Galeotti 2928* (lectotype, designated here, P).

This taxon was previously referred to *Miconia glaberrima* (Schlechtendal) Naudin, fide Cogniaux (1891), as well as Macbride (1941), Standley and Williams (1963), and Almeda (2001).

Selected specimen. MEXICO. **Chiapas:** Near Chiapas, *J. J. Linden 5* (syntype, P).

6. Miconia bracteolaris Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 150. 1850 [1851]. TYPE: French Guiana. Cayenne: *J. Martin s.n.* (lectotype, designated here, P; duplicates, P[2]).

This taxon was previously referred to *Miconia eriodonta* DC., fide Cogniaux (1891) and Wurdack et al. (1993).

Selected specimen. FRENCH GUIANA. **Cayenne:** *F. M. Leprieur s.n.* (syntypes, P [2]).

7. Miconia claussenii Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 143. 1850 [1851]. TYPE: Brazil. Minas Gerais: 1838, *P. Claussen s.n.* (lectotype, designated here, P; duplicates, K [2] [1636, 1 n°16], P).

This taxon was previously referred to *Miconia pepericarpa* DC., fide Cogniaux (1891).

Selected specimens. BRAZIL. **Minas Gerais:** 1838, *P. Claussen 566* (syntypes, BR [2], P [3]); 1842, *Dupré 61 B* (syntype, P).

8. Miconia fothergilla (DC.) Naudin var. **gracilipes** Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 120. 1850 [1851]. TYPE: Mexico. Oaxaca: 3000 ft. [1000 m], *H. G. Galeotti 2955* (lectotype, designated here, P; duplicates, C not seen, P, P fragment at BR).

This taxon was previously referred to *Miconia dodecandra* (Desrousseaux) Cogniaux var. *gracilipes* (Naudin) Cogniaux, fide Cogniaux (1891) and Wurdack (1980).

Selected specimen. MEXICO. **Oaxaca:** 1845, *F. M. Liebmann s.n.* (syntypes, C not seen, P).

9. Miconia impetiolaris (Swartz) D. Don var. **pandurifolia** Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 137. 1850 [1851]. TYPE: Panama. 1851, *E. Duchassaing s.n.* (lectotype, designated here, P; duplicates, P [2]).

Selected specimen. COLOMBIA. Near Guaduas, 1801, *A. J. Bonpland 1752* (syntypes, P [3]).

10. Miconia lucida Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 196. 1850 [1851]. *Acinodendron lucidum* (Naudin) Kuntze, Revis. Gen. Pl. 2: 951. 1891, "*Acinodendrum*." TYPE: Venezuela. "Andes de Truxillo et Merida," 4000–14500 ft. [1320–4785 m], 1843, *J. J. Linden 307* (lectotype, designated here, P; duplicates, BR, GH not seen, P).

This taxon was previously referred to *Miconia ulmarioides* Naudin, fide Cogniaux (1891), as well as Wurdack (1973).

Selected specimen. VENEZUELA. **Caracas:** 1842, *J. J. Linden 222* (syntype, P).

11. Miconia melanodendron Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 162. 1850 [1851]. TYPE: Brazil. Minas Gerais: 1838, *P. Claussen 560* (lectotype, designated here, P; duplicates, P [4], US).

This taxon was previously referred to *Miconia minutiflora* (Bonpland) DC., fide Cogniaux (1891), as well as D'Arcy (1987), Brako and Zarucchi (1993), Wurdack et al. (1993), Jørgensen and León-Yánez (1999), Almeda (2001), and Berry et al. (2001).

The year (1830) seen in the specimen label of *Poeppig 1741* from BR is probably a mistake.

Selected specimens. BRAZIL. s. loc., *Herb. Martius* [Herb. Bras. 505] (syntypes, BR, P); Bahia, *P. Salzman s.n.* (syntypes, BR, P [4]). PERU. s. loc., 1834, *E. F. Poeppig 1741* (syntype, P).

12. Miconia molybdea Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 185. 1850 [1851]. *Acinodendron molybdeum* (Naudin) Kuntze, Revis. Gen. Pl. 2: 952. 1891. TYPE: Bolivia. Santa Cruz: Sep. 1845, *F. de Castelnau 40* (lectotype, designated here, P). Figure 1.

Selected specimen. BOLIVIA. **Valle Grande:** *C. V. d'Orbigny 519* (syntype, P, P photo at F [F-223477] not seen).

13. Miconia myriocarpa Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 231. 1850 [1851]. TYPE: Mexico. Oaxaca: 1000 m, *H. G. Galeotti 2956* (lectotype, designated here, P).

This taxon was previously referred to *Miconia glaberrima* (Schlechtendal) Naudin, fide Cogniaux (1891), as well as Standley and Williams (1963).

Selected specimen. MEXICO. s. loc., 1845, *F. M. Liebmann s.n.* (syntype, P).

14. Miconia myrtillifolia Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 198. 1850 [1851]. *Acinodendron myrtillifolium* (Naudin) Kuntze, Revis. Gen. Pl. 2: 952. 1891, as "*Acinodendrum*." TYPE: Venezuela. "Truxillo et Merida," 2000–3000 m, 1842, *J. J. Linden 459* (lectotype, designated here, P; duplicates, BR, GH not seen, NY, P). Figure 2.

Selected specimen. VENEZUELA. **Mérida:** 6500 ft. [2145 m], Sep. 1846, *N. Funck & L. Schlim 918* (syntypes, BR [3], P [2]).

15. Miconia obovalis Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 183. 1850 [1851]. TYPE: Jamaica. *Wilson s.n.* (lectotype, designated here, P).

This taxon was previously referred to *Miconia splendens* (Swartz) Grisebach, fide Wurdack (1973), as well as Wurdack et al. (1993).

The lectotype has been mentioned by Wurdack (1971) and Wurdack et al. (1993), but without further information for the designation. No other record for this lectotypification has been found or seen on the specimen in P. Nevertheless, we confirm this lectotypification here, by choosing again the specimen of *Wilson s.n* at P cited in the protologue. Despite the fact that the specimen *A. J. Bonpland s.n.* from Brazil was also mentioned in the protologue, it actually belongs to *Miconia egensis* Cogniaux, and thus could not be chosen as the lectotype.

16. Miconia otodesma Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 205. 1850 [1851]. TYPE: Colombia. Near Bogota, *A. J. Bonpland s.n.* (lectotype, designated here, P; duplicate, P).

This taxon was previously referred to *Miconia squamulosa* (Smith) Triana, fide Triana (1871), as well as Cogniaux (1891) and Wurdack (1973).

Selected specimens. COLOMBIA. [As "Nlle. Grenade"], Bogota, 1844, *J. Goudot s.n.* (syntype, P). ECUADOR. Near Quito, *W. Jameson s.n.* (syntype, P not seen).

17. Miconia plukenetii Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 116. 1850 [1851]. *Acinoden-*

dron plukenetii (Naudin) Kuntze, Revis. Gen. Pl. 2: 952. 1891, as "*Acinodendrum*." TYPE: Guyana. *Rob. Schomburgk II 1008* (lectotype, designated here, P; duplicates, BM, K, P [2]).

Selected specimen. WEST INDIES. "Antilles," *ex Herb. Banks s.n.* (syntype, P, P photo at F [F-036278] not seen).

18. Miconia proteoides A. Saint-Hilaire & Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 141. 1850 [1851]. TYPE: Brazil. Rio de Janeiro: *C. Gaudichaud 736* (lectotype, designated here, P; duplicates, P [2]).

This taxon was previously referred to *Miconia cinerascens* Miquel, fide Cogniaux (1891) and Zuloaga (1999).

Selected specimens. BRAZIL. **Rio de Janeiro:** Corcovado, Jan. 1839, *Broth. M. Guillemin 253* (syntypes, P [2]); Rio de Janeiro, *Lalande 736* (syntype, P). **São Paulo:** *A. St. Hilaire s.n.* [Cat. 1113] (syntypes, P [2]).

19. Miconia rhamnoidea Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 226. 1850 [1851]. TYPE: Colombia. Near Quindiu, *A. J. Bonpland s.n.* (lectotype, designated here, P; duplicate, P).

This taxon was previously referred to *Miconia ligustrina* (Smith) Triana, fide Cogniaux (1891), as well as Wurdack (1980) and Jørgensen and León-Yánez (1999).

Selected specimens. COLOMBIA. [As "Nlle Grenade"], 1844, *J. Goudot s.n.* (syntype, P). PERU. Mt. Saraguru, *A. J. Bonpland s.n.* (syntype, P).

20. Miconia rhytidophylla Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 139. 1850 [1851], non *Miconia desmantha* Bentham, Pl. Hartw. 181. 1845. Replaced Name: *Clidemia desmantha* Bentham, in Hook. J. Bot. 2: 309. 1840. *Acinodendron rhytidophyllum* (Naudin) Kuntze, Revis. Gen. Pl. 2: 952. 1891. TYPE: Brazil. Amazonas: Pedrero, 1839–1840, *Rob. Schomburgk I. 884* (lectotype, designated here, P; duplicates, GH not seen, K not seen, NY [2], P [2], P fragment at BR).

Selected specimen. BRAZIL. "Brazil septentrional," s. loc., *Lalande s.n.* (syntype, P).

21. Miconia riedelii Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 125. 1850 [1851]. *Acinodendron riedelii* (Naudin) Kuntze, Revis. Gen. Pl. 2: 952. 1891. TYPE: Brazil. Minas Gerais: Feb. 1839, *L. Riedel 4* (lectotype, designated here, P; duplicates, G not seen, G photo at F [F-223582] not seen, P fragment at BR).

Selected specimen. BRAZIL. **Minas Gerais:** ad Parahyba, 1841, *P. Claussen 30* (syntype, P).

22. Miconia rivoeriae Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 170. 1850 [1851]. *Cremanium rivoeriae* (Naudin) Grisebach, Fl. Brit. W.I. 262. 1860. TYPE: Martinique. 1839, *Mlle Rivoire s.n.* (lectotype, designated here, P; duplicates, GH not seen, P [2]).

This taxon was previously referred to *Miconia trichotoma* (Desrousseaux) DC., fide Howard and Kellogg (1986).

Selected specimen. GUADELOUPE. s. loc., *F. L. L'Herminier s.n.* (syntypes, P [2]).

23. Miconia stellifera Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 142. 1850 [1851]. TYPE: Ecuador. Saraguru, *A. J. Bonpland s.n.* (lectotype, designated here, P).

This taxon was previously referred to *Miconia barbinervis* (Bentham) Triana, fide Almeda (2001).

Selected specimen. PERU. Prov. Maynas alto, *E. F. Poeppig 864* (syntype, P).

24. Miconia stipularis Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 194. 1850 [1851]. TYPE: Colombia. Mt. Quindiu, *A. J. Bonpland s.n.* (lectotype, designated here, P; duplicates, P [2]).

Selected specimen. COLOMBIA. **Bogotá:** ad Fusagasuga, *J. J. Linden 819* (syntypes, BR [3], G not seen, G photo at F [F-026039] not seen, P).

25. Miconia tentaculifera Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 241. 1850 [1851]. *Acinodendron tentaculiferum* (Naudin) Kuntze, Revis. Gen. Pl. 2: 953. 1891. TYPE: Brazil. Minas Gerais: *P. Claussen 54* (lectotype, designated here, P; duplicates, F, G, L, P [4]).

Selected specimens. BRAZIL. **Rio de Janeiro:** *Herb. Martius* [Herb. Bras. 944] (syntypes, BM, BR [2], FI, G, K, L, M, MO, NY, P, P photo at F [F-036302] not seen, S); **São Paulo:** *C. Gaudichaud 781* (syntype, P).

26. Miconia tococoides Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 127. 1850 [1851]. TYPE: Mexico. Oaxaca: Totutla, 1842, *A. B. Ghiesbrecht 65* (lectotype, designated here, P; duplicate, P).

This taxon was previously referred to *Miconia mexicana* (Bonpland) Naudin, fide Cogniaux (1891), as well as Sandley and Williams (1963), Balick et al. (2000), and Almeda (2001).

Selected specimen. MEXICO. **Oaxaca:** Xalapa, 4000 ft. [1320 m], 1840, *H. G. Galeotti 2922* (syntypes, BR [3], P [2]).

27. Miconia versicolor Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 189. 1850 [1851]. *Acinodendron versicolor* (Naudin) Kuntze, Revis. Gen. Pl. 2: 953. 1891. TYPE: Colombia. "Along the Orenoque Fl.," Popayán, *A. J. Bonpland 1915* (lectotype, designated here, P; duplicates, G not seen, P).

Selected specimen. COLOMBIA. [As "Nlle. Grenade"], 1844, *J. Goudot s.n.* (syntype, P).

28. Miconia verticilliflora Steudel ex Naudin, Ann. Sci. Nat., Bot., sér. 3, 16: 122. 1850 [1851]. TYPE: French Guiana. Cayenne: *J. Martin s.n.* (lectotype, designated here, P; duplicate, P).

This taxon was previously referred to *Miconia pubipetala* Miquel, fide Wurdack et al. (1993).

Note: Both syntypes as mentioned in the protologue of Naudin have been used previously by other authors for other species.

The collection *Hostman* or *Kappler 896* is the type of *Miconia pubipetala* Miquel described in 1850. The specimen *Schomburgk I. 483* was referred as the type of *Diplochita parviflora* by Bentham (1840) before its inclusion as a syntype within the description of *M. verticilliflora*.

Selected specimens. GUYANA. **Berbice:** *Rob. Schomburgk I. 483* (syntypes [type, *Diplochita parviflora* Bentham], BR, K not seen, P [3]). SURINAM. s. loc., *Hostman* or *Kappler 896* (syntypes [type, *Miconia pubipetala* Miquel], P [3], U not seen).

29. Octomeris macrodon Naudin, Ann. Sci. Nat., Bot., sér. 3, 4: 53. 1845. *Heterotrichum macrodon* (Naudin) Planchon ex Hooker f., Bot. Mag., t. 4421. 1849. *Miconia macrodon* (Naudin) Wurdack, Phytologia 22: 400. 1972. TYPE: Venezuela. "Andes of Trujillo and Lima," 1842, *J. J. Linden 365* (lectotype, designated here, P; duplicate, P).

Selected specimen. VENEZUELA. **Caracas:** Oct. 1843, *N. Funck 382* (syntype, P).

30. Staphidium triste Richard ex Naudin, Ann. Sci. Nat., Bot., sér. 3, 17: 320. 1852. TYPE: Surinam. Para: Feb.–Apr. 1844, *A. Kappler 1413a* (lectotype, designated here, P; duplicates, P [2]).

This taxon was previously referred to *Miconia bracteata* (DC.) Triana, fide Triana (1871), as well as Cogniaux (1891), Macbride (1941), Brako and Zarucchi (1993), Wurdack et al. (1993), and Berry et al. (2001).

Selected specimens. FRENCH GUIANA. Near Cayenne, 1838, *F. M. Leprieur 163* (syntype, P, P photo at F [F-223247] not seen).

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Una Especie Nueva de *Dalea* (Fabaceae: Amorpheae) Arbórea del Estado de Oaxaca, México

Rosalinda Medina and Mario Sousa S.

Instituto de Biología, Universidad Nacional Autónoma de México, Departamento de Botánica, Apartado Postal 70-367, 04510 México, D.F., México. rmedina@ibiologia.unam.mx

RESUMEN. Se describe *Dalea schiblii* Medina & M. Sousa (Fabaceae, Amorpheae), una especie nueva, arbórea, del bosque de *Pinus* L.–*Quercus* L., en el estado de Oaxaca, México. Se discuten y comparan sus características morfológicas con las de otras especies mexicanas de *Dalea* Lucanus. Se proporciona una clave para las especies del subgénero *Parosela* (Cavanilles) Barneby sección *Parosela* Barneby serie *Lasiostomae* (Rydberg) Barneby.

ABSTRACT. *Dalea schiblii* Medina & M. Sousa (Fabaceae, Amorpheae), a new arborescent species from *Pinus* L.–*Quercus* L. forest in the state of Oaxaca, Mexico, is described and illustrated. Its morphological characteristics are discussed and compared to those of other Mexican species of *Dalea* Lucanus. A key for the species of subgenus *Parosela* (Cavanilles) Barneby sect. *Parosela* Barneby ser. *Lasiostomae* (Rydberg) Barneby is provided.

Key words: Amorpheae, arborescent, *Dalea*, Fabaceae, Mexico, Oaxaca.

Dalea Lucanus (Fabaceae, Amorpheae) es un género americano con alrededor de 171 especies. Se distribuye en regiones templadas y tropicales secas, desde el sur de Canadá hasta Argentina y Chile, incluyendo las Antillas. Este género tiene su principal centro de diversificación en México (cerca de 145 especies) y otro centro secundario en los Andes. Las especies de este género son más abundantes y de mayor altura en los bosques de *Pinus* L.–*Quercus* L. de México y Centroamérica (Barneby, 1977). Los caracteres florales que permiten reconocer a las diferentes especies del género *Dalea* son: la forma y tamaño de los pétalos, nivel de inserción de éstos sobre la columna del androceo, la cohesión o separación de los pétalos de la quilla, el número de estambres, la forma y persistencia de las brácteas interflorales, las variaciones del cáliz (en la ornamentación glandular, el indumento y el tamaño de los dientes), el número de folíolos y la densidad de las espigas, entre otros. Barneby (1977) propuso la división del género en cinco subgéneros, para facilitar el manejo y comprensión de las diversas especies: *Asprolea* Barneby, *Dalea* L., *Parosela* (Cavanilles) Barneby, *Psoropteris* Barneby, *Theodora* Barneby. La especie descrita en este trabajo pertenece al subgénero *Parosela* por tener flores sésiles con pétalos epistémonos, todos libres y profundamente auriculados en la base, el par que forma la quilla está parcialmente adherido; androceo 10-mero, con los filamentos fusionados en 2/3 de su longitud formando un tubo.

Dalea schiblii Medina & M. Sousa, sp. nov. TIPO: México. Oaxaca: Dist. Pochutla, Mun. San Miguel del Puerto, Puerto Trino en el Cerro Lobo, 17 dic. 2003, *José Pascual 964* (holotipo, MEXU; isotipos, IEB, MO, OAX). Figura 1.

A congeneribus mexicanis *Daleae* Lucanus differt habitu arboreo, bracteis persistentibus, foliis ad 8 cm longis, (6)7 ad 9 paribus foliolorum 1.7 cm longis, calyce glabro, nitido, dentibus brevibus subaequalibus, non apiculatis, ad marginem dense ciliato, glandulis flavidis haud in ordinem, inter costas calycinas dispersis, androecio in carina incluso, haud exserto.

Árbol 5 m de alto; ramas pilosas y glandulares a glabrescentes con la edad. Hojas imparipinnadas, 5–8 × 2.3–3.4 cm, obovadas en contorno general; estípulas 1–1.5 mm, lanceolado-acuminadas, glándulas intrapeciolulares diminutas; las postpeciolulares inmersas en la base del raquis; pecíolos 5–9 mm, puberulentos; pecíolulos hasta 1 mm, puberulentos; folíolos (6)7 a 9 pares, 1.3–1.7 × 0.3–0.6 cm, el terminal de menor tamaño, obovados a elípticos, base cuneada, margen entero con tricomas escasos, ápice mucronulado, ocasionalmente emarginado, verdes y glabrescentes en el haz, más pálidos en el envés, con indumento diminuto, esparcido y numerosos puntos glandulares, sólo la nervadura central evidente. Inflorescencias axilares, en espigas hasta 4 × 2.5 cm, coniformes, flores numerosas; pedúnculos 1.5–2.5 cm, puberulentos; brácteas florales persistentes, ca. 3 × 2.5 mm, anchamente ovado-naviculares, corto-aristadas, con la base blanca desprovista de glándulas, el ápice verde-jaspeado, ciliado y con glándulas amarillas. Flores moradas con máculas blancas, cáliz 5-dentado, 3.5–4 mm de largo, glabro, lustroso, tubo 10-acostillado, 2.3–3.5 mm, glándulas amarillas dispersas entre las costillas, dientes subiguales ca. 1 mm, deltado-trian-

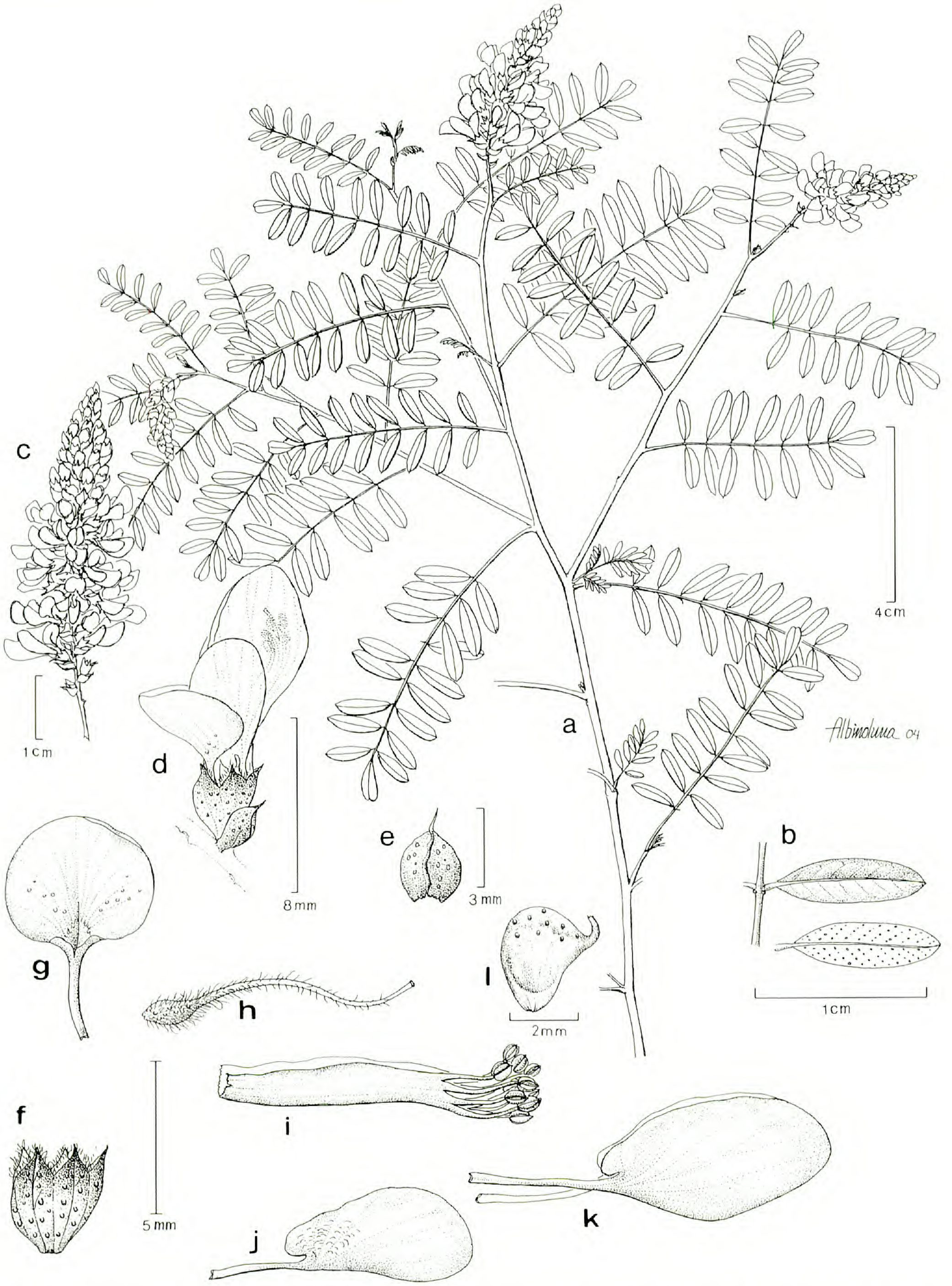

Figura 1. *Dalea schiblii* Medina & M. Sousa. —a. Rama con inflorescencia. —b. Detalle de un folíolo, haz y envés. —c. Detalle de la inflorescencia. —d. Flor. —e. Bráctea floral. —f. Cáliz. —g. Estandarte. —h. Gineceo. —i. Androceo. —j. Alas. —k. Quilla. —l. Fruto. Dibujo basado en el holotipo *Pascual 964* (MEXU).

gulares, borde densamente ciliado, no apiculados; corola con pétalos bicolores, estandarte blanco con dos máculas moradas hacia la base, ca. 6.5 × 5.2 mm, anchamente ovado, uña ca. 3 mm, con glándulas amarillas alineadas convergiendo hacia la base, base ligeramente enrollada, infundibuliforme, quilla morada, ca. 1.2 cm, la porción laminar ca. 7 × 4.1 mm, elíptico-obovada, uña ca. 5 mm, alas moradas con máculas blancas, hasta 9 mm, la porción laminar 5.5–6 × 3.2 mm, elíptico-obovadas, uña ca. 3 mm, los pétalos están adheridos; androceo ca. 1 cm, estambres 10, fusionados hasta 2/3 de su largo, libres 3–3.2 mm,

anteras ca. 0.2 mm, conectivo prolongado en una glándula apical oscura; gineceo hasta 1 cm, piloso en poco más de la mitad de su largo, ovario ca. 1.5 mm, fusiforme, estilo ca. 8.5 mm, estigma inconspicuo. Legumbres 2–3 × 1.5–2 mm, obcónicas, valvas hialinas, verdosas, la porción distal finamente carinada, pilosa, la superficie con escasas glándulas de color amarillo oro, sólo una semilla.

Distribución y hábitat. En la Sierra Madre del Sur (estado de Oaxaca, México), propuesta como provincia fisiográfica-florística para Oaxaca por García-Mendoza y Torres (1999); de esta provincia Sousa et al. (2004) citan siete especies de leguminosas endémicas. Crece en bosque de *Pinus* L.–*Quercus* L. sobre suelos pedregosos en elevaciones de 2572 m.

Fenología. Florece en diciembre. Fructifica en febrero.

Este hallazgo es resultado de las exploraciones de campo realizadas por el personal de la Sociedad para el Estudio de los Recursos Bióticos de Oaxaca (SERBO), confirmando una vez más la riqueza florística del estado y del género *Dalea* en México.

Dalea schiblii por sus caracteres florales se asemeja más a las especies del subgénero *Parosela* sección *Parosela* Barneby serie *Lasiostomae* (Rydberg) Barneby: *D. acracarpica* Barneby, *D. frutescens* A. Gray, *D. hegewischiana* Steudel y *D. hospes* (Rose) Bullock. Comparte con ellas las siguientes características: cáliz glabro y lustroso, con dientes de borde densamente ciliado, y estandarte de menor tamaño que la quilla. Sin embargo en *D. schiblii* las glándulas del cáliz no se encuentran alineadas, los dientes son similares entre si en tamaño, las brácteas florales son persistentes y las flores y las hojas son de mayor tamaño.

Dalea frutescens y *D. hospes* se distribuyen en el sur de Estados Unidos (de Arizona a Texas) y en el norte de México (de Chihuahua a Tamaulipas), ambas especies habitan en altitudes semejantes a las de *D. schiblii*, pero no en bosque templado de *Pinus–Quercus*, se encuentran habitando en zonas desérticas con matorral xerófilo o bosque espinoso con *Prosopis* L.

Dalea hegewischiana se encuentra en el centro y sur de México, en Hidalgo, Querétaro y en la región del Valle de Tehuacán-Cuicatlán en Puebla y Oaxaca, también dentro del matorral xerófilo, pero a diferencia de las especies anteriores que son arbustivas o hasta arbóreas, ésta es una hierba postrada perenne.

Dalea acracarpica es la especie, de esta serie, más recientemente descrita por Barneby (1990) del estado de Chiapas, México, habita al igual que *D. schiblii* en bosque de *Pinus–Quercus*, pero se diferencia de esta última por su porte arbustivo, no mayor a 1 m de alto, hojas de menor tamaño, 3.3 cm de largo, folíolos pequeños hasta 5 mm de largo, cáliz con dientes espiculados y flores menores a 5 mm de largo.

Por sus características tanto vegetativas como reproductivas, la nueva especie, tiene una estrecha afinidad con *Dalea frutescens*.

Etimología. Esta especie está dedicada a Leo Schibli (1958–2004), químico y naturalista suizo, nacido en Zurich, quien desde 1988 radicó en México. Fundador y, hasta su muerte, presidente de la Sociedad para el Estudio de los Recursos Bióticos de Oaxaca (SERBO) y gran entusiasta, quien junto con su compañera y esposa Silvia Salas, han aportado tanto al conocimiento florístico del estado de Oaxaca.

Paratipos. MÉXICO. **Oaxaca:** Dto. Pochutla, Mpio. San Miguel del Puerto, camino al Punto Trino, *A. Sánchez Martínez 1282* (MEXU), *1285* (MEXU).

Clave para las Especies del Subgénero *Parosela* Sección *Parosela* Serie *Lasiostomae*

1a. Pétalos amarillo-verdosos, sin máculas; folíolos 2 a 5 pares . . . . . *D. hospes*
1b. Pétalos morados o rosas, con máculas blancas; folíolos 5 a 15 pares.
  2a. Hierbas perennes; flores pediceladas . . . . . *D. hegewischiana*
  2b. Arbustos o plantas arborescentes; flores sésiles.
    3a. Arbustos, hojas hasta 4.5 cm de largo.
      4a. Dientes del cáliz apiculados . . . . . *D. acracarpica*
      4b. Dientes del cáliz no apiculados . . . . . *D. frutescens*
    3b. Árbol, hojas hasta 8 cm de largo . . *D. schiblii*

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Sousa S., M., R. Medina L., G. Andrade M. & M. L. Rico A. 2004. Leguminosas. Pp. 249–269 *en* A. J. García-Mendoza, M. J. Ordóñez & M. Briones-Salas (editors), Biodiversidad de Oaxaca. Instituto de Biología, UNAM–Fondo Oaxaqueño para la Conservación de la Naturaleza–World Wildlife Fund, México.

New Boraginales from Tropical America 5: New Names and Typifications for Neotropical Species of *Cordia* and *Varronia*

James S. Miller
New York Botanical Garden, Bronx, New York 10458-5126, U.S.A. jmiller@nybg.org

Abstract. Typifications and new combinations are provided for Boraginaceae from the Mesoamerica region in advance of the treatment for *Flora Mesoamericana*. In addition, the recognition of the genus *Varronia* P. Browne as separate from *Cordia* L. requires new names for various species to be treated in several floristic projects. *Cordia skutchii* I. M. Johnston is lectotypified, *V. tarodaea* J. S. Miller is a new name presented for *C. longifolia* A. DC., and the following new combinations are made: *V. andreana* (J. Estrada) J. S. Miller, *V. buddleoides* (Rusby) J. S. Miller, *V. bullulata* (Killip ex J. Estrada & García-Barriga) J. S. Miller, *V. dardani* (Taroda) J. S. Miller, *V. eggersii* (K. Krause) J. S. Miller, *V. guanacastensis* (Standley) J. S. Miller, *V. guaranitica* (Chodat & Hassler) J. S. Miller, *V. harleyi* (Taroda) J. S. Miller, *V. intonsa* (I. M. Johnston) J. S. Miller, *V. lauta* (I. M. Johnston) J. S. Miller, *V. leucocephala* (Moricand) J. S. Miller, *V. leucomalloides* (Taroda) J. S. Miller, *V. linnaei* (Stearn) J. S. Miller, *V. macrodonta* (Killip) J. S. Miller, *V. roraimae* (I. M. Johnston) J. S. Miller, *V. sangrinaria* (Gaviria) J. S. Miller, *V. setigera* (I. M. Johnston) J. S. Miller, *V. stenostachya* (Killip ex Gaviria) J. S. Miller, *V. steyermarkii* (Gaviria) J. S. Miller, and *V. urticifolia* (Chamisso) J. S. Miller.

Key words: Boraginaceae, *Cordia*, Cordiaceae, Neotropics, *Varronia*.

Boraginaceae have traditionally been treated as comprising four subfamilies, Cordioideae, Ehretioideae, Heliotropioideae, and Boraginoideae, but recent molecular data indicate Hydrophyllaceae and Lennoaceae are both nested within the family as traditionally defined (Gottschling et al., 2005). Recent authors have recognized a more broadly defined Boraginales, with the four traditional subfamilies treated at the familial level (Cordiaceae, Ehretiaceae, Heliotropiaceae, and Boraginaceae), plus Hydrophyllaceae and Lennoaceae. Recent efforts to examine generic limits within Cordiaceae (Gottschling et al., 2005; Gottschling & Miller, 2006; Miller & Gottschling, 2007) have been completed prior to the preparation of a number of floristic projects in the Neotropics. In anticipation of those efforts, the nomenclature of species traditionally included in *Cordia* L. has been reviewed, and several species require typification or new combinations. These are presented below prior to submission of treatments for various floristic projects.

Cordia skutchii I. M. Johnston, J. Arnold Arbor. 21: 339. 1940. TYPE: Guatemala. Quezaltenango: Palamar, 1140 m, 12 Oct. 1934, *A. F. Skutch 1426* (lectotype, designated here, GH).

In naming this species, Johnston (1940) listed two of Skutch's collections (1425 and 1426) as types. *Skutch 1425* is a collection of a male plant, but *Skutch 1426* has both female flowers and fruits, so it is chosen here as a lectotype.

New Combinations in *Varronia* P. Browne

Most modern authors have followed Ivan Johnston (summarized in Miller, 2001a) in treating *Cordia* in a broad sense, but recent molecular studies (Gottschling et al., 2005) clearly show that the ca. 100 Neotropical species of multi-stemmed shrubs with serrate leaves and condensed inflorescences, which have been recognized as section *Varronia*, are sister to the rest of the genus and best recognized as a separate genus. Most of the required combinations exist, either through the work of early authors when opinions on generic delimitation varied widely, or from the recent nomenclatural review of Borhidi et al. (1988). However, the choice of appropriate names for some species has not been clarified, and in some cases new combinations are required. These clarifications and new combinations are provided below.

1. **Varronia andreana** (J. Estrada) J. S. Miller, comb. nov. Basionym: *Cordia andreana* J. Estrada, Fl. Colombia 14: 76. 1995. TYPE: Colombia. Magdalena: Cerro Palangana, E of Molino, 900 m, s.d., *O. Haught 4041* (holotype, COL; isotype, US).

Varronia andreana is a recently described species that is known only from the Colombian departments of Boyacá and Magdalena and is most closely related to

V. caput-medusae (Taubert) Friesen, with which it shares the presence of glandular hairs but differs in having inflorescences less than 2 cm long, as opposed to ca. 8 cm in the latter.

2. Varronia buddleoides (Rusby) J. S. Miller, comb. nov. Basionym: *Cordia buddleoides* Rusby, Mem. Torrey Bot. Club 6: 83. 1896. TYPE: Bolivia. La Paz: Mapiri, 1872, *M. Bang 1530* (holotype, NY; isotype, K).

This is a morphologically variable species that ranges from northern Brazil to Peru and Bolivia and is most closely related to *Varronia mollissima* (Killip) Borhidi and *V. guazumaefolia* Desvaux, but it can be separated from them by its calyx lobes that end in prolonged filiform tips and upper leaf surface that is glabrous or nearly so. However, there are morphological intermediates, and the complex needs further study.

3. Varronia bullulata (Killip ex J. Estrada & García-Barriga) J. S. Miller, comb. nov. Basionym: *Cordia bullulata* Killip ex J. Estrada & García-Barriga, Fl. Colombia 14: 70. 1995. TYPE: Colombia. s. loc., s.d., *J. C. Mutis 1956* (holotype, MA-MUT; isotypes, MA, US).

This species from Cundinamarca and Boyacá, Colombia, is closely related to *Varronia bullata* L. and *V. subtruncata* (Rusby) Friesen, but it differs in its red-brown pubescence and in having the inner surface of its calyx puberulent.

4. Varronia dardani (Taroda) J. S. Miller, comb. nov. Basionym: *Cordia dardani* Taroda, Notes Roy. Bot. Gard. Edinburgh 44: 111. 1986. TYPE: Brazil. Pernambuco: entre Carnaubeira-Belém de São Francisco, 17 May 1971, *E. P. Heringer et al. 862* (holotype, UB).

Known only from Pernambuco, Brazil, this species differs from others with terminal spicate inflorescences in its triangular-ovate leaves and lax inflorescences.

5. Varronia eggersii (K. Krause) J. S. Miller, comb. nov. Basionym: *Cordia eggersii* K. Krause, Bot. Jahrb. Syst. 37: 628. 1906. TYPE: Ecuador. "Prope Balao," 22 Feb. 1892, *H. F. A. von Eggers 14472* (holotype, B not seen, B photo at F).

This species from lowland western Ecuador is questionably distinct from other South American species with axillary spicate inflorescences with the peduncle adnate to the petiole, but further study will be necessary to resolve species limits.

6. Varronia guanacastensis (Standley) J. S. Miller, comb. nov. Basionym: *Cordia guanacastensis* Standley, Field Mus. Nat. Hist., Bot. Ser. 18: 982. 1938. TYPE: Costa Rica. Guanacaste: Bagaces, 29 June 1930, *A. M. Brenes 12713* (holotype, F 855662; isotypes, CR, NY).

This species occurs from Guerrero, Mexico, to Costa Rica. Borhidi et al. (1988) published the combination *Varronia coyucana* (I. M. Johnston) Borhidi, but the two names have been considered synonymous (e.g., Miller, 2001b) and the combination for the earlier name is necessary.

7. Varronia guaranitica (Chodat & Hassler) J. S. Miller, comb. nov. Basionym: *Cordia guaranitica* Chodat & Hassler, Bull. Herb. Boissier, ser. 2, 5: 305. 1905. TYPE: Paraguay. Cordillera de Altos, Oct. 1897, *E. Hassler 3381* (holotype, G-BOIS; isotypes, B, BM, G).

This easily recognized species occurs from northern Argentina into Paraguay and Bolivia and is distinctive in its low growth habit, narrowly oblanceolate leaves without evident secondary veins, terminal capitate inflorescences, and calyx teeth that lack filiform appendages.

8. Varronia harleyi (Taroda) J. S. Miller, comb. nov. Basionym: *Cordia harleyi* Taroda, Notes Roy. Bot. Gard. Edinburgh 44: 128. 1986. TYPE: Brazil. Bahia: Morro de Chapéu, ca. 8 km SW of the town of Morro do Chapéu, W of the rd. to Utinga, 3 Mar. 1977, *R. M. Harley, S. J. Mayo, R. M. Storr, T. S. Santos & R. S. Pinheiro 19312* (holotype, CEPEC; isotypes, E, K, MO).

This is a distinctive endemic of Bahia, Brazil, with ovate, crenate leaves, inflorescences with peduncles 2.3–7 cm long, and calyx lobes that lack filiform apices.

9. Varronia intonsa (I. M. Johnston) J. S. Miller, comb. nov. Basionym: *Cordia intonsa* I. M. Johnston, Contr. Gray Herb. 92: 28. 1930. TYPE: Brazil. Minas Gerais: betw. Salgado and Vao do Paranan, Sep. 1818, *C. F. P. von Martius s.n.* (holotype, B).

This species is perhaps only a hirsute form from Minas Gerais, Brazil, of *Varronia curassavica* Jacquin, but the species of *Varronia* with spicate inflorescences are taxonomically difficult and are in terrible need of a comprehensive review.

10. Varronia lauta (I. M. Johnston) J. S. Miller, comb. nov. Basionym: *Cordia lauta* I. M. Johnston, J. Arnold Arbor. 37: 288. 1956. TYPE: Mexico. Jalisco: Plan de Barrancas, 2500–3500 ft., 17 July 1951, *H. S. Gentry & C. L. Gilly 10878* (holotype, A; isotypes, MEXU, MICH).

In describing this species, Johnston (1956) noted its unusually large pollen and generally distinct morphology, including the largest corolla (6–8.2 cm long) in the genus. It is still known only from a few collections from Jalisco and Nayarit (*Miller & Tellez 6312*, MO).

11. Varronia leucocephala (Moricand) J. S. Miller, comb. nov. Basionym: *Cordia leucocephala* Moricand, Pl. Nouv. Amer. 148. 1846. *Lithocardium leucocephalum* (Fresenius) Kuntze, Revis. Gen. Pl. 2: 977. 1891. TYPE: Brazil. Bahia: Pouco d'Areia near Jacobina, *J. S. Blanchet 3880* (holotype, G; isotype, BM).

Varronia leucocephala is one of a large number of species with small terminal capitate inflorescences with calyx teeth that lack filiform projections. It can be recognized from the other species by its 2.5–3.5 cm long corolla, minutely serrulate leaf margin, and white tomentose calyx.

12. Varronia leucomalloides (Taroda) J. S. Miller, comb. nov. Basionym: *Cordia leucomalloides* Taroda, Notes Roy. Bot. Gard. Edinburgh 44: 125. 1986. TYPE: Brazil. Bahia: 6 km from Filadélfia on rd. BA 385 to Itúba, 18 Feb. 1974, *R. M. Harley 16143* (holotype, CEPEC; isotypes, E, K).

This species, known only from Paraíba in northeastern Brazil, is presumably closely related to *Varronia leucomalla* (Taubert) Borhidi, both of which share a distinctive white tomentose lower leaf surface. *Varronia leucomalloides* differs in having leaves less than 4 cm long, as opposed to *V. leucomalla*, which has much larger leaves greater than 8 cm and is known only from Rio de Janeiro.

13. Varronia linnaei (Stearn) J. S. Miller, comb. nov. Basionym: *Cordia linnaei* Stearn, J. Arnold Arbor. 52: 627. 1971. Type: Jamaica. St. Andrews: pastures behind Hope Gardens, 600–700 ft., 22 Oct. 1956, *G. Proctor 15789* (holotype, BM; isotype, IJ).

This species, which occurs from southern Mexico to Colombia and is also found in Jamaica, has a particularly contorted nomenclatural history (reviewed in Stearn, 1971). It occurs sympatrically throughout much of its range with *Varronia inermis* (Miller) Borhidi, but it differs in having consistently axillary small capitate inflorescences.

14. Varronia macrodonta (Killip) J. S. Miller, comb. nov. Basionym: *Cordia macrodonta* Killip, J. Washington Acad. Sci. 17: 328. 1927. TYPE: Peru. Piura: San Antonio, 1200 m, Mar. 1912, *A. Weberbauer 6015* (holotype, F; isotype, US).

This Peruvian endemic is distinct in its small cymose inflorescences and distinctly serrate leaves with subulate teeth.

15. Varronia roraimae (I. M. Johnston) J. S. Miller, comb. nov. Basionym: *Cordia roraimae* I. M. Johnston, Fieldiana, Bot. 28: 511. 1953. TYPE: Venezuela. Bolivar: SW forested slopes betw. Rondon Camp and base of sandstone bluffs, Mt. Roraima, 2040–2255 m, 30 Sep. 1944, *J. A. Steyermark 59003* (holotype, F; isotypes, GH, VEN).

This species is apparently restricted to tepuis in southern Venezuela (Johnston, 1953). It appears closely related to *Varronia spinescens* (L.) Borhidi and is similar in general appearance, but it differs in having narrow lanceolate leaves and inflorescences less than 2 cm long, but 5–7 mm thick, which is less than half the typical length and twice the normal thickness of *V. spinescens*.

16. Varronia sangrinaria (Gaviria) J. S. Miller, comb. nov. Basionym: *Cordia sangrinaria* Gaviria, Mitt. Bot. Staatssamml. München 23: 222. 1987. TYPE: Venezuela. Barinas: 10 km from Barinitas along rd. to Apartaderos, 800 m, 10 Oct. 1964, *F. Breteler 4258* (holotype, MER; isotypes, F, G, M, MO, NY, U).

This is a distinctive species that is apparently endemic to western Venezuela and is easily recognized by having leaves with evident tertiary venation, sharp apiculate leaf serrations, an even, brown indumenta on all parts, capitate inflorescences, and calyx lobes with prolonged filiform apices.

17. Varronia setigera (I. M. Johnston) J. S. Miller, comb. nov. Basionym: *Cordia setigera* I. M. Johnston, J. Arnold Arbor. 16: 176. 1935. TYPE: Brazil. Minas Gerais: near Fazenda Bom Jardim, Rio Jequitinhonha, 1817, *A. F. C. P. de St. Hilaire 1478* (holotype, P).

Apparently endemic in Minas Gerais, this species has only rarely been collected, and its relationships are not evident. However, it is distinctive and can easily be recognized by its capitate inflorescences, filiform calyx teeth, and 5–18 mm long corollas.

18. Varronia stenostachya (Killip ex Gaviria) J. S. Miller, comb. nov. Basionym: *Cordia stenostachya* Killip ex Gaviria, Mitt. Bot. Staatssamml. München 23: 243. 1987. TYPE: Venezuela. "Prope Maypures ad flumen Orinoco," June 1854, *R. Spruce 3642* (holotype, K; isotypes, K, W).

Varronia stenostachya is one of the more distinctive species of the group within *Varronia* characterized by spicate inflorescences and is easily recognized by its ovate leaves and its mixture of axillary and terminal, spicate inflorescences, which are free from the petioles.

This species is endemic to granitic outcrops, or lajas, that surround Puerto Ayacucho in southern Venezuela.

19. Varronia steyermarkii (Gaviria) J. S. Miller, comb. nov. Basionym: *Cordia steyermarkii* Gaviria, Mitt. Bot. Staatssamml. München 23: 200. 1987. TYPE: Venezuela. Lara: Sanare, 1358 m, May 1930, *J. Saer D'Heguert 480* (holotype, M; isotypes, F, VEN).

Varronia steyermarkii is known from several disjunct populations in Venezuela (Gaviria, 1987); it is distinctive and easily recognized by its narrow lanceolate leaves that are sessile or nearly so, capitate inflorescences, and calyx teeth that lack filiform projections.

20. Varronia tarodaea J. S. Miller, nom. nov. Basionym: *Cordia longifolia* A. DC., Prodr. 9: 495. 1845. TYPE: Brazil. Bahia: 1834, *J. S. Blanchet 1739* (holotype, G-DC; isotypes, BM, G, K).

There are only two known species of *Varronia* that have entire leaf margins and brochidodromous venation (the other being *V. poliophylla* (Fresenius) Borhidi). Both species are endemic to Bahia, Brazil, and may be separated by *V. tarodaea* being entirely glabrous, while *V. poliophylla* is pubescent on stems, calyces, and both leaf surfaces. Sessé and Moçiño's (1893) name *V. longifolia* blocks the transfer of the epithet long associated with this species in the genus *Cordia*, so the new name honors Neusa Taroda, who did so much fine work on the species of *Varronia* in Brazil.

21. Varronia urticifolia (Chamisso) J. S. Miller, comb. nov. Basionym: *Cordia urticifolia* Chamisso, Linnaea 4: 483. 1829. TYPE: Brazil. "Brasilia tropica," s.d., *F. Sellow s.n.* (holotype, G not seen, G photo at MO).

This species appears to be closely related to *Varronia polycephala* Lamarck and other species of *Varronia* with branched inflorescences. Taroda and Gibbs (1986) recognized it as distinct based on its axillary panicles on robust peduncles and densely hirsute stems. It is restricted to southern Brazil and Paraguay.

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Physaria scrotiformis (Brassicaceae), a New High-Elevation Species from Southwestern Colorado and New Combinations in *Physaria*

Steve L. O'Kane Jr.
Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50614-0421, U.S.A.
steve.okane@uni.edu

Abstract. *Physaria scrotiformis* O'Kane (Brassicaceae) is a newly described, diminutive, long-lived perennial from the upper subalpine–lower alpine zone of the San Juan Mountains of southwestern Colorado. The species grows on windswept, nearly barren exposures of Leadville limestone on West Silver Mesa. The species is another example of a taxon bridging the gap between the synonymized genera *Lesquerella* S. Watson and *Physaria* (Nuttall ex Torrey & A. Gray) A. Gray s. str. Additionally, the following new combinations and changes in status are made and keys are provided where needed: *P. carinata* (Rollins) O'Kane & Al-Shehbaz subsp. *paysonii* (Rollins) O'Kane, *P. carinata* (Rollins) O'Kane & Al-Shehbaz subsp. *pulchella* (Rollins) O'Kane, *P. didymocarpa* (Hooker) A. Gray subsp. *lanata* (A. Nelson) O'Kane, *P. didymocarpa* (Hooker) A. Gray subsp. *lyrata* (C. L. Hitchcock) O'Kane, *P. floribunda* Rydberg subsp. *osterhoutii* (Payson) O'Kane, *P. geyeri* (Hooker) A. Gray subsp. *purpurea* (Rollins) O'Kane, *P. hitchcockii* (Munz) O'Kane & Al-Shehbaz subsp. *confluens* (Maguire & A. H. Holmgren) O'Kane, *P. kingii* (S. Watson) O'Kane & Al-Shehbaz subsp. *kaibabensis* (Rollins) O'Kane, *P. kingii* (S. Watson) O'Kane & Al-Shehbaz subsp. *utahensis* (Rydberg) O'Kane, *P. lepidota* Rollins subsp. *membranacea* (Rollins) O'Kane, *P. newberryi* A. Gray subsp. *yesicola* (R. C. Sivinski) O'Kane, and *P. saximontana* Rollins subsp. *dentata* (Rollins) O'Kane.

Key words: Brassicaceae, Colorado, IUCN Red List, *Lesquerella*, North America, *Physaria*.

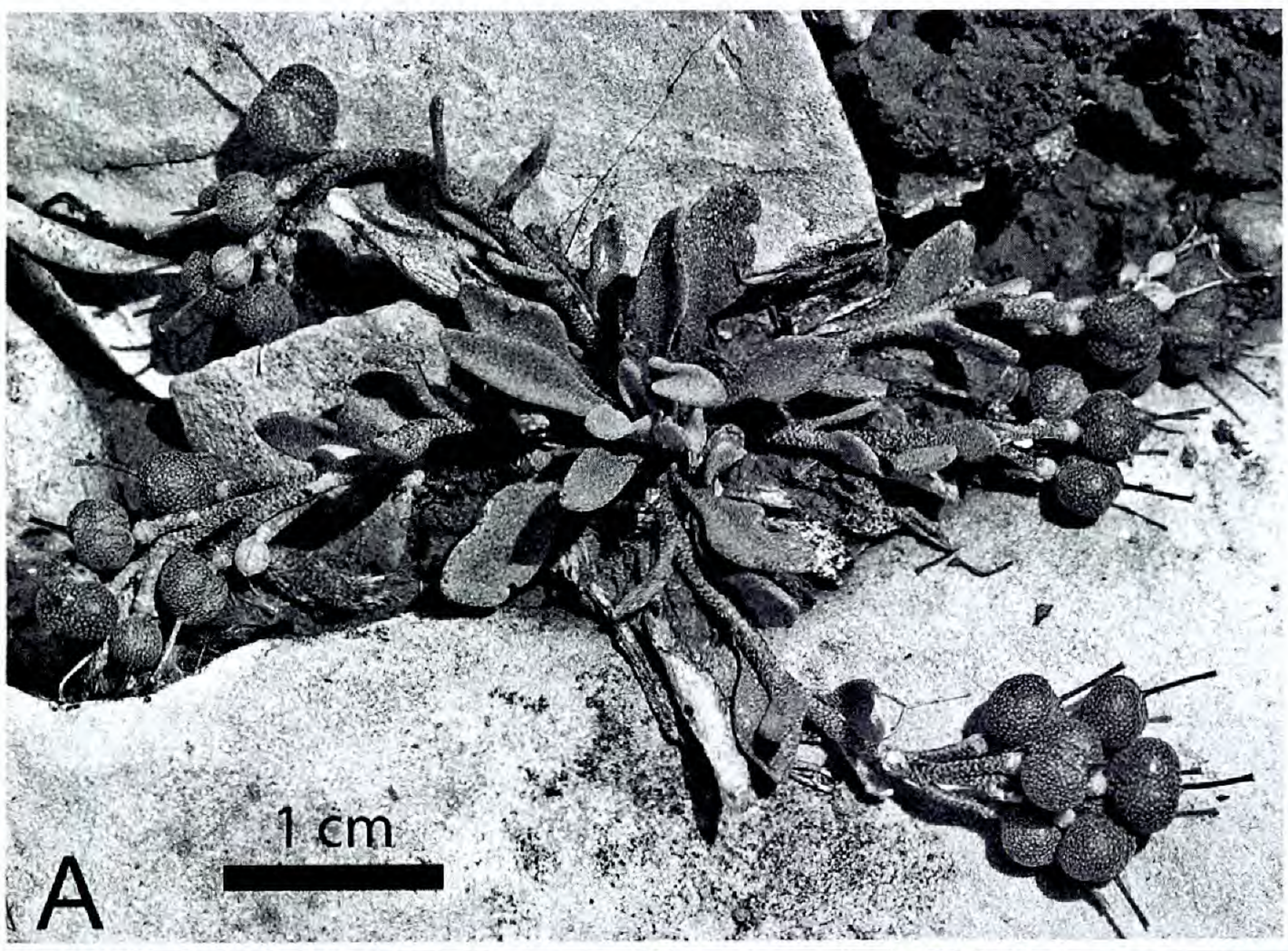
High-elevation species of *Physaria* (Nuttall ex Torrey & A. Gray) A. Gray are found in Montana, Idaho, Wyoming, Utah, Nevada, and central Colorado in the western United States. These rare species inhabit windswept, fell-field habitats with stony or gravelly substrates formed primarily from limestone, dolomite, or metamorphic derivatives of these. Most other species of the genus grow in arid, usually warm or hot, lower-elevation habitats. In the San Juan Mountains of southwestern Colorado, limestone in the upper subalpine or alpine is rare (Western Geographics, 1991; Steven et al., 1974). A new species of *Physaria* was discovered in these mountains in the summer of 2006 by Ken Heil, Dave Jamieson, and me while conducting the final fieldwork toward the completion of the Flora of the Four Corners project (Heil & O'Kane, 2003). Recent fieldwork in the Four Corners area (where Arizona, Colorado, New Mexico, and Utah meet) has yielded three other novelties in *Physaria*: *P. pulvinata* O'Kane & Reveal and *P. vicina* (J. L. Anderson, Reveal & Rollins) O'Kane & Al-Shehbaz at montane elevations (Anderson et al., 1997; O'Kane & Reveal, 2006), and *P. navajoensis* (O'Kane) O'Kane & Al-Shehbaz at lower, drier elevations (O'Kane, 1999). It is not surprising that the botanically little-explored San Juan Mountains would contain another botanical novelty.

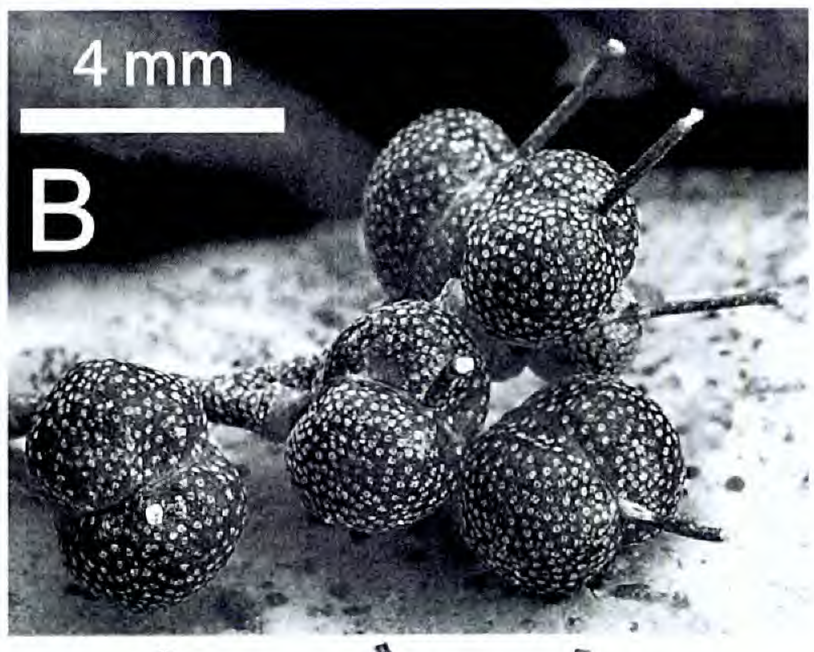
New combinations and status changes in *Physaria* are given following the discussion of the new species in order that they may be included in an upcoming volume of the *Flora of North America*. These actions are necessitated because of the recent transfer of most species of *Lesquerella* S. Watson to *Physaria* (Al-Shehbaz & O'Kane, 2002). Distributions given below are summarized in Rollins (1993), Rollins and Shaw (1973), and Holmgren (2005).

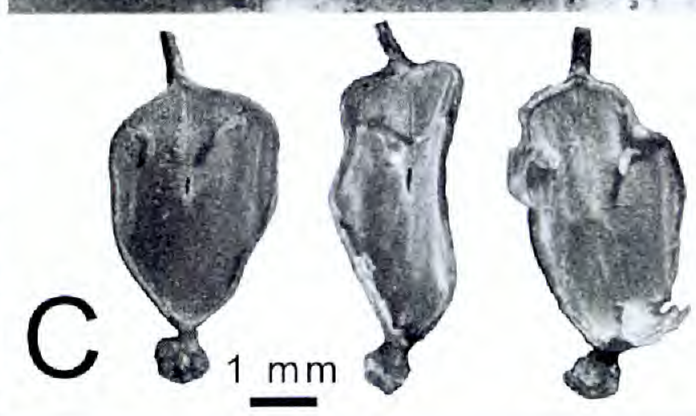
Physaria scrotiformis O'Kane, sp. nov. TYPE: U.S.A. Colorado: La Plata Co., San Juan Mtns., S end of West Silver Mesa ca. 0.1 mi. N of hiking trail to City Reservoir, 37°33.009′N, 107°37.555′W, 11,827 ft. (3605 m), 19 July 2006, *S. L. O'Kane, Jr. 7977 with K. Heil & D. Jamieson* (holotype, MO; isotypes, ARIZ, ASU, BRY, COLO, CS, GH, ISTC, K, NMC, NY, RM, RSA, SJNM, UNM). Figure 1.

Haec species *Physariae hemiphysariae* (Maguire) O'Kane & Al-Shehbaz similis, sed ab ea lamina foliari ad petiolum minus subito attenuata atque fructus valvis non compressis distinguitur.

Herbs, long-lived perennials from a simple or sparsely branched underground caudex, to 3.5 cm × 8 mm, elongating with age, distally with a short thatch of old leaf bases; stems (0)1 to 5 per plant, 0.8–3 cm, unbranched, purple-green, arising lateral to (beneath)







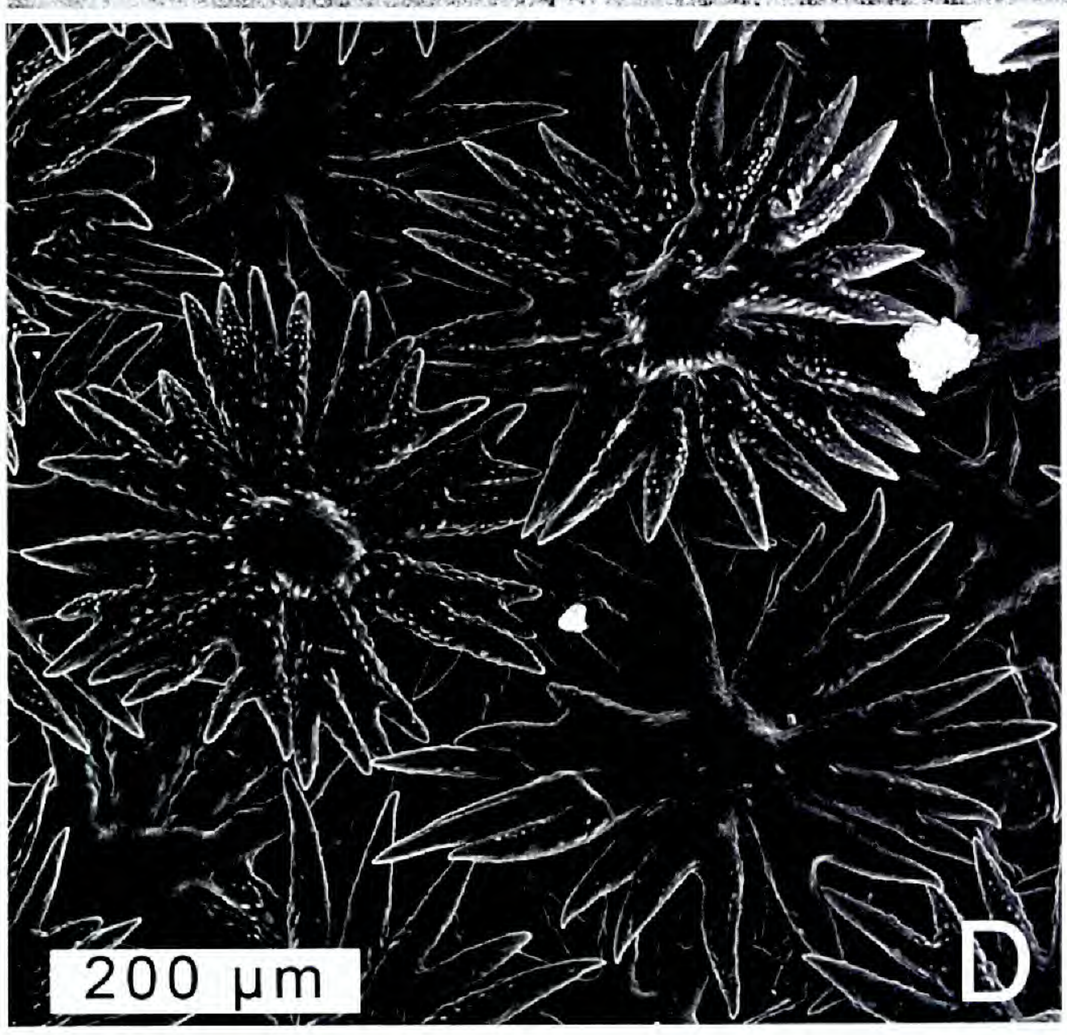


Figure 1. *Physaria scrotiformis* O'Kane. —A. Plant habit (*O'Kane & Jamieson 8003*, ISTC). —B. Silicles (*O'Kane & Jamieson 8003*, ISTC). —C. Repla, false septa, and funicles (type *O'Kane et al. 7977*, MO). Deformity on the right of the center replum is from pressing, and the stigmas have been truncated in the photographs. —D. SEM of adaxial leaf trichomes (*O'Kane et al. 7977*). Bright objects are grains of soil. Note that the lower-level trichomes have fewer tubercles and little or no umbo. —E. View of limestone habitat looking north from the type location (*O'Kane et al. 7977*) near the City Reservoir Trail. Plants are found on the drier limestone knolls. The ridge in the distance is on average ca. 4.5 km distant.

the erect or ascending tuft of basal leaves, prostrate to slightly decumbent, from stem tip to stem tip plants to 10 cm, but typically less than 5.5 cm diam. (Fig. 1A); herbage silvery gray-green to silvery purple, the silver color due to a dense, overlapping covering of small stellate trichomes, these 150–250 µm diam., with 5 or 6(7) main rays, each bifurcating, sometimes incompletely so that only 3 tips are present, trichomes short and stout compared to most other species of the genus, ray tips 18 to 29 per trichome, rays moderately tuberculate to nearly smooth, trichome center strongly umbonate to simply low-mounded, those trichomes with more tubercles tending to have larger umbos, the lower layer of trichomes tending to be smoother (Fig. 1D); basal leaves entire, oblanceolate, elliptic or rhombic, mostly flat, sometimes somewhat folded, attenuate at base and tapering to a slightly winged petiole, apex rounded to rounded-acute, including the petiole 0.6–2.7 cm × 2–5 mm, encrusted with trichomes, the basal tuft of leaves to 3(–4) cm diam.; cauline leaves entire, elliptic to oblanceolate, short-petiolate to essentially entire, 3 to 7 per stem, including the petiole 3–5 × 1.2–2 mm. Infructescence not elongating appreciably, a raceme with 3 to 7, ± crowded fruits, these on straight, ascending pedicels 1.8–3.4 mm long. Flowers not seen. Silicles (Fig. 1B) on stipes 0.2–0.5 mm, ovoid to obpyriform, slightly but obviously didymous (especially in living material), apex rounded, flattened, or even slightly emarginate; base rounded-obtuse; wider than long; 3–

4.5 × 3.7–5 mm, the valves inflated and a little wider than the replum; valves glabrous within, the exterior with scattered trichomes; becoming purple or greenish purple at maturity; ovules 2 or 3(4) per locule (Fig. 1C), these attached to the upper 1/5–2/5 of the replum, within a locule typically 1 on each side or 2 on one side and 1 on the other; false septum entire or medially small-perforate (Fig. 1C); replum obovate to rounded-obdeltoid, rounded to obtuse or truncate at the apex; styles linear, 2–3.6 mm, including the truncate stigma, which is the same width as the style; seeds (1)2 to 3 per locule, entirely filling the locule, flattened, typically rounded on one side and ± flat or concave on the other, relatively plump, purple-brown, ovate to suborbicular, 1.9–2.2 × 1.6–2 mm, apparently not mucilaginous (although examined seed may have been slightly immature), wingless; cotyledons accumbent.

Etymology and ecology. *Physaria scrotiformis* (meaning "pouch-shaped," referring to the inflated, pubescent, seed-filled, and somewhat didymous fruits), the "West Silver bladderpod," is known only from the southern portion of West Silver Mesa from the City Reservoir hiking trail north to where the cap of Mississippian-age Leadville limestone (or less probably Ouray limestone) ends (Steven et al., 1974). Its habitat consists of fellfield-like windblown, cobbly and gravelly limestone outcrops in a matrix of *Picea engelmannii* Parry ex Engelmann islands and tundra and upper subalpine vegetation (Fig. 1E). Associates on the nearly barren spots where the species occurs include *Minuartia obtusiloba* House, *Zigadenus elegans* Pursh, *Castilleja haydenii* (A. Gray) Cockerell, *Pseudocymopterus montanus* J. M. Coulter & Rose, *Poa alpina* L., *Hymenoxys grandiflora* (Torrey & A. Gray) K. F. Parker, *Allium geyeri* S. Watson, *Townsendia rothrockii* A. Gray, and *Trisetum spicatum* (L.) K. Richter. The plants grow in shallow soil between gray and tan-gray limestone cobbles (Fig. 1A) or gravels. Similar limestone habitats on Lime Ridge to the west were searched unsuccessfully for the species. It is likely that *P. scrotiformis* is limited to West Silver Mesa. No flowers were found at the time of collection, even after diligent searching for late-blooming individuals. The species probably flowers in late June or early July. Among species of *Physaria*, however, attributes of the flower vary little and are seldom diagnostic unless they are exceptionally large, e.g., *P. pulchella* (Rollins) O'Kane & Al-Shehbaz, or are white rather than the nearly ubiquitous yellow, e.g., *P. purpurea* (A. Gray) O'Kane & Al-Shehbaz.

IUCN Red List category. Although rare, this new species is probably not currently endangered by direct human activities because the whole of its habitat is contained within the Weminuche Wilderness Area. With no appropriate contiguous or nearby limestone substrate at higher elevations to allow for population migration, however, global warming could present a real threat to the species, especially if vegetation types at lower elevations were to invade the inhabited sites. Based on the limited aerial extent of the known (and perhaps only) metapopulation of this species, it can be listed according to IUCN Red List criteria (2001) as EN (Endangered) under Criterion B2a.

Taxonomy and relationships. Morphologically, *Physaria scrotiformis* bridges the nebulous divide between the traditional, and now-synonymized, genera *Lesquerella* and *Physaria* s. str. in that its fruits are somewhat inflated and slightly didymous (Fig. 1B). Mulligan (1968) postulated that *Physaria* could be distinguished from *Lesquerella* in having the replum narrower than the valves rather than as wide as the valves as in *Lesquerella*. Although the valves of *P. scrotiformis* are clearly (but slightly) wider than the replum, it is hard to imagine that it could have been included in *Physaria* s. str. Several other species bridge the *Lesquerella/Physaria* gap in their fruit morphology: *P. cordiformis* Rollins, *P. geyeri* (Hooker) A. Gray, *P. obcordata* Rollins, *P. hemiphysaria* (Maguire) O'Kane & Al-Shehbaz, and *P. wyndii* (Rollins & E. Shaw) O'Kane & Al-Shehbaz are good examples. *Physaria inflata* (Rollins & E. A. Shaw) O'Kane & Al-Shehbaz is especially close to *Physaria* s. str. in its strongly inflated, balloon-like, thin-walled silicles about 1 cm long, which are sometimes slightly didymous as well. Consequently, and as argued in Al-Shehbaz and O'Kane (2002), *Lesquerella* and *Physaria* cannot be maintained as separate genera based on any known criteria. One might reason that the silicles of *P. scrotiformis* are not inherently subdidymous, but, rather, they appear so because of being filled with seeds that fully occupy and physically expand the valves. However, fruits with aborted ovules have the same shape as those with seeds. *Physaria scrotiformis* is probably most closely related to *P. hemiphysaria* from Utah on the Wasatch and West Tavaputs Plateaus and the southwestern rim of the Uinta Basin. They both share a similar leaf shape (wider and more rhombic in *P. hemiphysaria*) and both have subdidymous fruits, these being inflated and with rounded valves in *P. scrotiformis* and little-inflated and angustiseptate-compressed in *P. hemiphysaria*. A relationship to *P. arctica* (Wormskjöld ex Hornemann) O'Kane & Al-Shehbaz also seems probable based on leaf shape; purplish, somewhat inflated fruits with trichomes absent or scattered; and an analogous habitat that is alpine rather than arctic. *Physaria*

scrotiformis has much shorter stems and infructescences, however, being less than 3 cm long rather than up to 30 cm long in *P. arctica*. Both species share similar nearly barren limestone habitats. This relationship is not surprising given the known long-distance disjunctions between the San Juan Mountains and the northern Rocky Mountains or the Arctic, e.g., *Bupleurum americanum* J. M. Coulter & Rose (Apiaceae), *Corydalis caseana* A. Gray (Fumariaceae/Papaveraceae), *Huperzia haleakalae* (Brackenridge) Holub (Lycopodiaceae), *Salix serrisima* (Bailey) Fernald (Salicaceae) (see Weber, 2003).

Paratype. U.S.A. **Colorado:** La Plata Co., SW end of West Silver Mesa just E of where the trail descends to Virginia Gulch, 11,687 ft. (3562 m), 20 July 2006, *S. L. O'Kane Jr. & D. Jamieson 8003* (BRY, COLO, ISTC, MO, SJNM).

New Combinations and Status Changes

The following novel combinations and status changes are necessitated by both the recent transfer of most species of *Lesquerella* to *Physaria* (Al-Shehbaz & O'Kane, 2002) and because subspecies are favored over varieties for an upcoming volume of the *Flora of North America* (Al-Shehbaz, pers. comm.).

Physaria carinata

Physaria carinata (Rollins) O'Kane & Al-Shehbaz subsp. **paysonii** (Rollins) O'Kane, comb. et stat. nov. Basionym: *Lesquerella paysonii* Rollins, Contr. Gray. Herb. 171: 44. 1950. TYPE: U.S.A. Wyoming: Lincoln Co., mtns. near Cottonwood Lake, E of Smoot, *Payson & Armstrong 3816* (holotype, GH; isotypes, COLO, MO).

Physaria carinata (Rollins) O'Kane & Al-Shehbaz subsp. **pulchella** (Rollins) O'Kane, comb. et stat. nov. Basionym: *Lesquerella pulchella* Rollins, Novon 5: 72. 1995. TYPE: U.S.A. Montana: Beaverhead Co., barren calcareous soil in open spruce woodland on S-facing slope along Trapper Creek just S of Hecha Mines, Pioneer Mtns., T3S R11W, Sec. 32, 8600 ft., *Peter Lesica 5525 & Steve Cooper* (holotype, GH; isotype, MONTU).

Physaria carinata is notable for its strongly angustiseptate fruits with valves that are pubescent on both the exterior and interior. Recent collections from east-central Idaho show intergradation between and among subspecies *paysonii*, subspecies *pulchella*, and subspecies *carinata*. The later taxon was already noted to be synonymous with subspecies *languida*, as *Lesquerella carinata* Rollins var. *languida* Rollins (Al-Shehbaz & O'Kane, 2002). All three taxa can easily be accommodated in an expanded concept of *P. carinata* at the subspecific level. The three often-sympatric subspecies of *P. carinata* can be distinguished as follows, but intergrades appear to be common.

Key to the Subspecies of *Physaria carinata*

1a. Silicles with valves evidently sharply keeled; silicles ellipsoid to orbicular; valve margins completely covering the replum edges.
  2a. Silicles nearly orbicular to broadly elliptic, rounded above and below . . . . . *P. carinata* subsp. *pulchella*
  2b. Silicles ellipsoid, the apex ± acute, the base narrow-rounded to acute . . . . . *P. carinata* subsp. *carinata*

1b. Silicles with valve margins thin but clearly rounded; silicles ellipsoid; valve margins not completely covering the replum margins. . . . . *P. carinata* subsp. *paysonii*

Physaria didymocarpa

Physaria didymocarpa (Hooker) A. Gray subsp. **lanata** (A. Nelson) O'Kane, stat. nov. Basionym: *Physaria didymocarpa* var. *lanata* A. Nelson, Bull. Torrey Bot. Club 31: 241. 1904. TYPE: U.S.A. Wyoming: Big Horn Co., rocky slopes, head of Middle Fork of Powder R[iver], 19 July 1901, *Gooding 326* (holotype, RM; isotypes, GH, NY, US).

Physaria didymocarpa (Hooker) A. Gray subsp. **lyrata** (C. L. Hitchcock) O'Kane, stat. nov. Basionym: *Physaria didymocarpa* var. *lyrata* C. L. Hitchcock, Univ. Wash. Publ. Biol. 17: 530. 1964. TYPE: U.S.A. Idaho: Lemhi Co., in talus along E slope of Salmon Mtns., near mouth of North Fork Williams Creek, 1 July 1945, *C. L. Hitchcock 14305 & C. V. Muhlick* (holotype, WTU).

A key to the varieties (here subspecies) of *Physaria didymocarpa* is given in Rollins (1993). Here, however, I am recognizing *P. integrifolia* (Rollins) Lichvar at the species rank rather than as *P. didymocarpa* var. *integrifolia* Rollins.

Physaria floribunda

Physaria floribunda Rydberg subsp. **osterhoutii** (Payson) O'Kane, stat. nov. Basionym: *Physaria osterhoutii* Payson, Ann. Missouri Bot. Gard. 5: 146. 1918. TYPE: U.S.A. Colorado: Grand Co., Kremmling, June 1907, *G. E. Osterhout 3477* (holotype, NY; isotype, NY).

A key to the two infraspecific taxa of *Physaria floribunda* is given in Rollins (1993), where both were considered at the varietal rank. Although the two subspecies of *P. floribunda* do morphologically

approach one another, *P. floribunda* subsp. *osterhoutii* has a limited distribution in Grand, Park, and Routt Counties, Colorado, and seems not to intergrade with the typical variety in the vicinity.

Physaria geyeri

Physaria geyeri (Hooker) A. Gray subsp. **purpurea** (Rollins) O'Kane, stat. nov. Basionym: *Physaria geyeri* (Hooker) A. Gray var. *purpurea* Rollins, Rhodora 41: 401. 1939. TYPE: U.S.A. Idaho: Custer Co., Challis Creek, 25 July 1916, *E. B. Payson 3448* (holotype, GH; isotype, NY).

A key to the two varieties of *Physaria geyeri* is given in Rollins (1993), which distinguishes these two taxa now recognized at the subspecific rank.

Physaria hitchcockii

Physaria hitchcockii (Munz) O'Kane & Al-Shehbaz subsp. **confluens** (Maguire & A. H. Holmgren) O'Kane, comb. nov. Basionym: *Lesquerella hitchcockii* Munz subsp. *confluens* Maguire & A. H. Holmgren, Madroño 11: 174. 1951. TYPE: U.S.A. Nevada: Nye Co., ridge N of Cherry Creek Pass, Quinn Canyon Range, 7000 ft., 20 June 1945, *B. Maguire & A. H. Holmgren 25534* (holotype, NY; isotypes, CAS, MO, POM, UC, US).

Previously Al-Shehbaz and I (2002) treated *Lesquerella rubicundula* Rollins as one of two subspecies of *Physaria hitchcockii* (subsp. *rubicundula* (Rollins) O'Kane & Al-Shehbaz). It is clear that a third infraspecific taxon of *P. hitchcockii* requires recognition as indicated by Holmgren (2005). The three subspecies of *P. hitchcockii* may be distinguished as follows.

Key to the Subspecies of *Physaria hitchcockii*

1a. Lowermost leaves differentiated (sometimes weakly) into a blade and petiole, blade oblanceolate to obovate; caudex elongated and elastic or not; Nevada and the Table Cliff Plateau, Utah.
  2a. Plants with elongate, elastic caudex branches, forming loose mats; silicles 1.7–3 mm wide; Grant, Quinn Canyon, and Schell Creek Ranges, Nevada . . *P. hitchcockii* subsp. *confluens*
  2b. Plants with a short, branched caudex, not elongated or elastic, forming small tufted mats; silicles 1.4–1.5(–2) mm wide; Table Cliff Plateau, Utah (limited to the white member of the limestone Claron Formation) and limestones of the Sheep Range and Spring Mountains of Nevada . . . . . *P. hitchcockii* subsp. *hitchcockii*
1b. Lowermost leaves with not a hint of differentiation between petiole and blade, blade linear-oblanceolate; caudex elongated and elastic; Paunsaugunt, Aquarius, and Markagunt Plateaus, Utah (limited to the pink member of the limestone Claron Formation) . . . . . *P. hitchcockii* subsp. *rubicundula*

Physaria kingii

Physaria kingii (S. Watson) O'Kane & Al-Shehbaz subsp. **kaibabensis** (Rollins) O'Kane, stat. nov. Basionym: *Lesquerella kaibabensis* Rollins, Contr. Gray Herb. 211: 110. 1982. *Physaria kaibabensis* (Rollins) N. H. Holmgren, Brittonia 56(3): 247. 2004. TYPE: U.S.A. Arizona: Coconino Co., 18.6 mi. S of Jacob Lake on rd. to the N entrance to Grand Canyon Natl. Park, 8 June 1979, *R. C. Rollins & K. W. Rollins 79191* (holotype, GH; isotypes, BRY, MO, NY, UC, US).

Physaria kingii (S. Watson) O'Kane & Al-Shehbaz subsp. **utahensis** (Rydberg) O'Kane, comb. et stat. nov. Basionym: *Lesquerella utahensis* Rydberg, Bull. Torrey Bot. Club 30: 252. 1903. TYPE: U.S.A. Utah: Utah Co., American Fork Canyon, 9000 ft., 31 July 1880, *M. E. Jones 1354* (holotype, NY; isotypes, DS, MO, POM, US).

Welsh (2003: 289) noted that the "[s]egregation of *P. kingii* from *P. wardii* is tenuous...." Holmgren (2005), also recognizing the overwhelming similarity of these two taxa, considered the former species a synonym of *Physaria wardii* (S. Watson) O'Kane & Al-Shehbaz as *P. kingii* var. *parvifolia* (Maguire & A. H. Holmgren) S. L. Welsh, which was referred to as *P. kingii* subsp. *latifolia* (A. Nelson) O'Kane & Al-Shehbaz by Al-Shehbaz and O'Kane (2002). Furthermore, Al-Shehbaz and I (2002) considered *Lesquerella kaibabensis* Rollins indistinguishable from *P. wardii*. After further review of specimens and photographs, I find that I agree with Holmgren (2005) in that *P. kaibabensis* (Rollins) N. H. Holmgren should be recognized, but differently as an infraspecific taxon of *P. kingii*. Additionally, the similarities of *P. utahensis* (Rydberg) O'Kane & Al-Shehbaz to *P. kingii* have been followed by both Holmgren (2005) and Welsh (2003; referring to *P. wardii*). A key to the subspecies of *P. kingii* follows.

Key to the Subspecies of *Physaria kingii*

1a. Valves of the silicle mostly pubescent on the inside; silicle slightly broader than long, the apex truncate or retuse.
  2a. Basal leaf blades sinuate or lobed, often lyrate; plants of northeastern Oregon . . . *P. kingii* subsp. *diversifolia* (Greene) O'Kane & Al-Shehbaz
  2b. Basal leaf blades ± entire (may be slightly lobed or widened at the blade base); plants of eastern California and Nevada . . . . . *P. kingii* subsp. *kingii*

1b. Valves of the silicle glabrous on the inside; silicle as wide as long or longer than wide, the apex rounded-acute.
3a. Pedicels recurved in a single arch or recurved and slightly sigmoid; plants of northern Nevada, southeastern Oregon, southern and northern (but apparently not central) Idaho . . . . . *P. kingii* subsp. *cobrensis* (Rollins & E. A. Shaw) O'Kane & Al-Shehbaz
3b. Pedicels straight or sigmoid, but not recurved.
4a. Petals pure white, 4.5–8.5 mm long; mature styles less than 2 mm long; endemic to the Kaibab Plateau of northern Arizona . . . . . *P. kingii* subsp. *kaibabensis*
4b. Petals yellow (occasionally cream-yellow or cream-white on the Kaibab Plateau of northern Arizona), 6–13 mm long; mature styles greater than (2)2.5 mm long; northern Arizona (including the Kaibab Plateau), California, Nevada, and Utah.
5a. Mature styles 6–9 mm long; ovules 2 to 4 per locule; plants erect; southeastern California . . . . . *P. kingii* subsp. *bernardina* (Munz) O'Kane & Al-Shehbaz
5b. Mature styles (2–)2.5–6 mm long; ovules 2 to 8 per locule; plants erect to prostrate.
6a. Raceme not secund in fruit; silicle ± densely pubescent; seeds usually 4 to 8 per locule; plants erect to prostrate; eastern California, northern Arizona, southern half of Nevada, and Utah. . . . . *P. kingii* subsp. *latifolia* (A. Nelson) O'Kane & Al-Shehbaz
6b. Raceme secund in fruit; silicle sparsely pubescent; seeds usually 2 per locule; plants prostrate; northern Utah . . . . . *P. kingii* subsp. *utahensis*

Physaria lepidota

Physaria lepidota Rollins subsp. **membranacea** (Rollins) O'Kane, stat. nov. Basionym: *Physaria membranacea* Rollins, Brittonia 33: 335. 1981. TYPE: U.S.A. Utah: Kane Co., steep chip-rock slide, 1/4 mi. W of jct. of Utah Hwy. 15 & U.S. Hwy. 89, betw. Kanab & Zion Natl. Park, 20 mi. E of park entrance, 10 June 1979, *R. C. Rollins & K. W. Rollins 79198* (holotype, GH; isotypes, BRY, NY, RM, UC, US).

A key to the taxa of *Physaria chambersii* Rollins is given in Holmgren (2005), treated as varieties. It is probable that *P. lepidota* subsp. *membranacea* is a stabilized hybrid, perhaps ancient, between *P. lepidota* subsp. *lepidota* and one of the infraspecies of *P. chambersii*. As such, *P. lepidota* subsp. *membranacea* could as easily be accommodated as a subspecies of *P. chambersii* rather than of *P. lepidota*. Rollins (1981) was apparently cognizant of this situation when he transferred his *P. chambersii* var. *membranacea* Rollins to *P. lepidota* var. *membranacea* (Rollins) Rollins. Here I have chosen to focus on the trichome rays, which are fused for about half their length (they are nearly fully fused in *P. lepidota*), a rare characteristic in the genus.

Physaria newberryi

Physaria newberryi A. Gray subsp. **yesicola** (R. C. Sivinski) O'Kane, stat. nov. Basionym: *Physaria newberryi* var. *yesicola* R. C. Sivinski, Sida 18: 673. 1999. TYPE: U.S.A. New Mexico: Valencia Co., T6N R3W, Sec. 2 NW 1/4 of NW 1/4, NE side of Sierra Lucero ca. 37 km W of Los Lunas, 4 May 1998, *R. Sivinski & McDonald 4335* (holotype, UNM; isotypes, ARIZ, BRY, CAS, GH, ISTC, MO, NY, US).

Physaria saximontana

Physaria saximontana Rollins subsp. **dentata** (Rollins) O'Kane, stat. nov. Basionym: *Physaria saximontana* Rollins var. *dentata* Rollins, Contr. Gray Herb. 214: 14. 1984. TYPE: U.S.A. Montana: Lewis & Clark Co., on upper E slope of mtn. S of Solk Lake, 8100 ft., Bob Marshall Wilderness, SE 1/4 sec. 31, T24N, R11W, 26 July 1979, *K. H. Lackschewitz 9106* (holotype, GH; isotype, MONTU).

A key to the two subspecies of *Physaria saximontana* is given in Rollins (1993), as varieties.

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A New Species in the *Tillandsia utriculata* Complex (Bromeliaceae) from Mexico

Iván M. Ramírez M. and Germán Carnevali F. C.

Herbarium CICY, Centro de Investigación Científica de Yucatán A.C., Calle 43 #130, Colonia Chuburná de Hidalgo, Mérida 97200, Yucatán, México. ramirez@cicy.mx; carneval@cicy.mx

Abstract. *Tillandsia tehuacana* I. Ramírez & Carnevali, a new species in the *T. utriculata* (L.) L. complex (Bromeliaceae) from Puebla, Mexico, is described and illustrated. The new entity is similar to *T. makoyana* Baker, but the rosettes are cylindrical (vs. funnelform), the leaves are coriaceous (vs. sclerotic), the leaves have a proportionately larger sheath compared with the lamina (vs. leaves with the sheath and lamina subequal), and the rachis of the inflorescence is sharply flexuous (vs. straight). The new species is also characterized by its habit, since it usually grows in dry thorn-scrub-cactus associations, while *T. makoyana* grows in different vegetation types, including oak and low deciduous forests. The new entity is also similar to *T. pinicola* I. Ramírez & Carnevali, but the new taxon differs by its larger rosette and inflorescence, its tubular rosette with leaves that are gray and purple and white lepidote on both sides (vs. a funnelform rosette with green leaves and only sparsely white lepidote abaxially), the floral bracts much shorter than the sepals (vs. subequal), the flowers ovate in shape (vs. tubular), and the three stigmatic lobes twisted together (vs. not twisted together).

Resumen. Se describe e ilustra *Tillandsia tehuacana* I. Ramírez & Carnevali, una nueva especie del complejo *T. utriculata* (L.) L. (Bromeliaceae). La nueva especie es similar a *T. makoyana* Baker, pero sus rosetas son cilíndricas (vs. en forma de embudo), sus hojas son coriáceas (vs. escleróticas), con una vaina proporcionalmente más larga que la lámina (vs. hojas con la vaina y la lámina subiguales) y el raquis de la inflorescencia es fuertemente flexuoso (vs. recto). También se caracteriza por crecer en matorral xerófilo asociada con cactus, mientras que *T. makoyana* crece en bosques de encino y selvas bajas caducifolias. La nueva especie también es similar a *T. pinicola* I. Ramírez & Carnevali pero tiene unas rosetas cilíndricas con hojas grises y bandas púrpuras, blanco lepidotas en ambas caras e inflorescencias de mayor tamaño (vs. rosetas en forma de embudo con hojas verdes en ambas caras, ligeramente lepidotas en la cara abaxial e inflorescencia tan larga o ligeramente mas larga que la roseta), brácteas florales más cortas que los sépalos (vs. subiguales), flores son ovoides en forma general (vs. tubular) y los tres lóbulos del estigma son conduplicado-espiralados (vs. conduplicados pero no espiralados).

Key words: Bromeliaceae, Mexico, Puebla, *Tillandsia*.

The genus *Tillandsia* L. (subfamily Tillandsioideae) is the largest genus of Bromeliaceae in Mexico, with ca. 192 species, of which 133 are endemic (Espejo-Serna et al., 2004). A description of the *T. utriculata* (L.) L. complex and the species included within it was discussed by Ramírez et al. (2004) and Ramírez and Carnevali (2007), when describing two new entities in the same complex: *T. aesii* I. Ramírez & Carnevali and *T. pinicola* I. Ramírez & Carnevali, both endemic to Mexico.

As part of an ongoing floristic project on the bromeliaceous flora of Mexico, a new species became evident in the state of Puebla. Herbarium specimens of this new species have been previously identified as *Tillandsia makoyana* Baker, but it clearly represents a different entity that is well characterized by rosette and inflorescence characters. We were able to assess this by collecting fertile material in the field and comparing it with other live plants and herbarium specimens of species belonging to the *T. utriculata* complex, such as *T. makoyana*, *T. limbata* Schlechtendal, *T. dasyliriifolia* Baker, *T. pinicola*, and *T. aesii*.

Within the genus *Tillandsia*, some species complexes can only be understood using this two-fold approach, because most of the key characters required to diagnose the taxa become lost upon drying. In many cases, the scarcity of herbarium data fails to expose the often subtle ecological and geographical patterns of sympatric or parapatric species, which can only be disclosed with extensive fieldwork, collections of live plants, and an abundant herbarium record.

Tillandsia tehuacana I. Ramírez & Carnevali, sp. nov. TYPE: Mexico. Puebla: Mpio. Caltepec, carr. del pueblo de Caltepec a San Luis Atolotitlán, 18°10′45″N, 97°27′14″W, 2120 m, vegetación xerófila con cactáceas columnares y plantas suculentas, 1 Mar. 2005, *Iván Ramírez M. & Carlos Durán 1296* (holotype, CICY [5]). Figure 1.

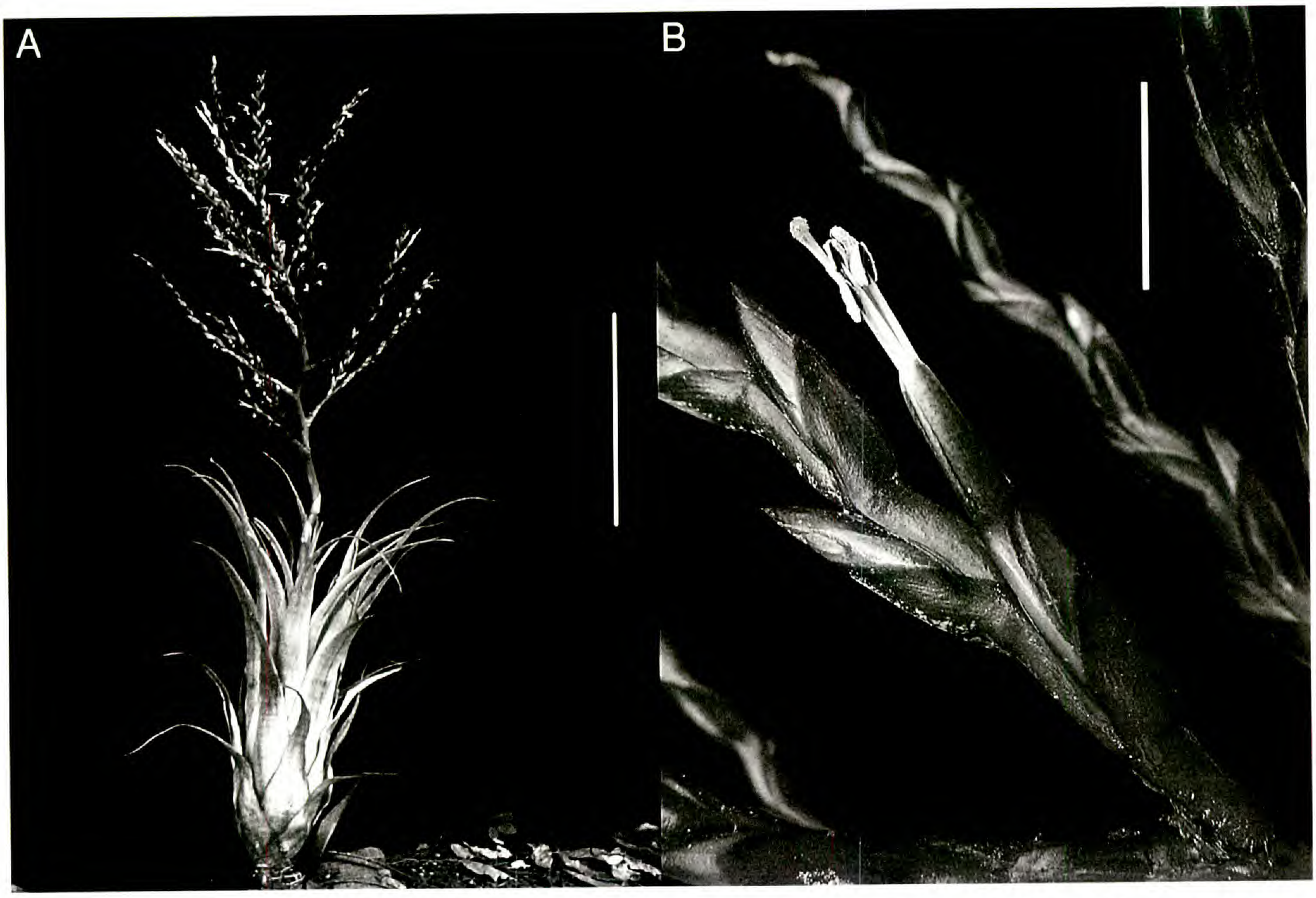

Figure 1. *Tillandsia tehuacana* I. Ramírez & Carnevali. —A. Habit. Scale bar = 20 cm. —B. Detail of flower. Scale bar = 2.5 cm. Based on the holotype, *I. Ramírez & C. Durán 1296* (CICY). Photographs by Francisco Lorea-Hernández.

Haec species *Tillandsiae makoyanae* Baker similis sed rosula cylindrica nec infundibuliformi, vaginis foliaribus argyro-purpureis suffusis atque coriaceis nec scleroticis, floriis actinomorphis nec zygomorphis, filamentis stylisque pallidis viridibus nec albis differt.

Epiphytic *herb*, 120–130 cm high. *Rosette* and inflorescence almost equal in length, rosette with 25 to 30 leaves when flowering, forming a cylindrical rosette, to 25–30 cm diam., the size of leaves shorter on the more external ones, gradually increasing in size toward the rosette center, leaf tips slightly divergent, foliar sheaths impounding. *Foliar sheaths* erect, gray, white lepidote externally, somewhat concave, conspicuously nerved, drying castaneous, much darker on the adaxial surface, oblong to widely elliptic, 13–19 × 7–9 cm, gradually merging into the blade; *foliar blades* narrowly triangular at base, long-attenuate and acute, coriaceous, rather soft, conspicuously nerved abaxially, (18–)28–40 × (3.2–)5.5–6 cm, gray and white lepidote on both surfaces, conspicuously nerved. *Inflorescence* a bipinnate panicle, to 80–85 cm, oblong, spikes ca. 14, ca. 5 of these branched, short branches to (6–)10–14 cm, long branches to 19–27 cm, 4 to 8 flowers on short spikes, 10 to 15 flowers on longer ones, some branches with the first 2 bracts sterile, glabrous but with a resinous substance on the axils of branches and basal flower on each spike; *peduncle* as long as the leaves when blooming (when dry and flattened, leaves slightly longer than peduncle), reddish pink, glabrous, 50–55 × 1.2–1.3 cm, covered by tubular, acute, imbricate bracts, base almost completely enclosing the peduncle, sheath and blade distinct, sheaths widely triangular, 2.5–4.5 × 3.3–3.6 cm, abruptly tapering into a narrowly triangular blade, 4–13 × 4–6 cm, white lepidote on both surfaces, in sharp contrast between the red, shiny peduncle and the white lepidote bracts, these erect with the tip slightly diverging from peduncle, usually longer than internodes but these exposed, upper ones shorter than internodes; *internodes* 2.5–5 cm; *rachis* red or reddish pink, to 0.7 cm diam., strongly flexuous, glabrous, dorsoventrally flat with flowers in 2 rows; *bracts of the spikes* widely triangular, acute and short-acuminate, base cordate, 2.2–3.5 × 2–2.4 cm, entire, slightly pink, densely white lepidote; *floral bracts* triangular to oblong-triangular, nerved, acute, navicular, red, margin hyaline drying sometimes dark purple, slightly white lepidote adaxially, barely covering the rachis, 1.3–1.5(–2.4) × 0.1–1.1(–1.5) mm, subequal in length to sepals but inserted below them and appearing much shorter when flower is open; *pedicel* thick, 5 × 5 mm. *Flowers* 5–6 cm, actinomorphic, erect, each flower lasting 1 day, protandrous, odorless, basally geniculate; *corolla*

forming a tube that is wider at base; *sepals* widely elliptic, acute, rounded, 2.3–2.5 × 1–1.2 cm, 2 of them basally connate by 6 mm, green, red margins, shiny, longer than floral bract; *petals* narrowly oblong, rounded, 3–3.1 × 5–6 mm, slightly oblique, constricted ca. 2 cm distally from base, lilac, free portion ca. 1.2–1.5 cm; *stamens* exserted, in 2 series, 1 slightly shorter than the other, filaments light green, plicate, 3.5–4 cm; *anthers* black, 8–9 mm, dorsifixed, pollen yellow; *ovary* 9–10 mm, pyramidal; *stigma* exserted, slightly protruding above the anthers at anthesis, conduplicate-spiral, to 4 cm, basally light green, apically apple green. *Fruit* a septicidal capsule (3–)3.5–4 × 0.7–0.8 mm.

Habitat, distribution, and phenology. *Tillandsia tehuacana* is restricted to dry slopes and valleys covered by shrubby, sparse vegetation with many cacti (including tall columnar species), thorny legumes, and *Bursera* Jacquin ex L. All known populations occur in the Tehuacán Valley, in the Mexican state of Puebla, at 2000–2220 m elevation. It has been collected in flower in March, and fruiting collections are known from February and July. The inflorescence produces a transparent, sometimes yellowish resin at the base of the branches.

Eponymy. The name is based on the type locality from the Tehuacán Valley.

Tillandsia tehuacana is one of the most distinctive members of the *T. utriculata* complex, at least when living specimens can be studied. Herbarium specimens of *T. tehuacana* have been previously identified as *T. makoyana*, but these specimens differ from the latter in the cylindrical shape of the rosette (vs. funnelform in *T. makoyana*), the coriaceous and not sclerotic foliar sheaths (vs. sclerotic in *T. makoyana*), and the light green filaments and style (vs. white in *T. makoyana*). Rosettes of *T. tehuacana* seem to be monocarpic because we did not observe offsets in the studied specimens as they are observed in other members of the complex (i.e., *T. dasyliriifolia*). The species occurs at low densities, in thorn-scrub-cactus associations, at elevations between 1000 and 2200 m. On the other hand, although *T. makoyana* rosettes also tend to be monocarpic, they occur at higher densities in a variety of vegetation types, including oak forests and low caducifolious forests, at elevations of up to 1700 m (pers. obs.). Also, *T. tehuacana* flowers in March, while *T. makoyana* mainly blooms in August. It is difficult to distinguish between these species with herbarium material, but *T. tehuacana* has softer leaves, usually drying dark gray or black, while the leaves of *T. makoyana* tend to dry a paler gray hue. Floral bracts in the new entity generally have a dark purple margin, a character usually not present in the other species. In addition, dry flowers of *T. tehuacana* feature stigmas that look much longer than stamens, an effect caused by the shrinkage of plicate filaments and/or perhaps the enlargement of style.

Paratypes. MEXICO. **Puebla:** mun. Zapotitlán Valley area along rd. from Chazumba, Oaxaca to Acatepec, betw. Calipa & Acatepec, *C. E. Smith Jr., F. A. Peterson & Narcisso Tejeda 3998* (F); Zapotitlán Valley area near Cerro Tarántula betw. Teloxtoc & San Juan Raya, 21 July 1961, *C. E. Smith Jr., F. A. Peterson & Narcisso Tejeda 4000* (F); mpio. Tehuacán, Paraje Cruz Santa Ana, Santa Ana Teloxtoc, 17 Feb. 1998, *E. Guízar & A. Castañeda 3935* (UAMIZ); La Huerta, near Tehuacán, 17 Feb. 1905, *William Trelease s.n.* (MO 3264986), cultivated at the Missouri Botanical Garden (132/04/32), 9 May 1904 (MO-3264984), cultivated at the Missouri Botanical Garden (130/04/36), 15 Aug. 1905, *G. E. McClure s.n.* (MO 3264987, MO 3264988).

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Moussonia adpressipilosa (Gesneriaceae), a New Solitary-Flowered Species from Mexico and Guatemala

Angélica Ramírez-Roa

Departamento de Botánica, Instituto de Biología, Universidad Nacional Autónoma de México, México D.F. 04510, México. gerang@servidor.unam.mx

Abstract. *Mousonnia adpressipilosa* D. L. Denham ex Ramírez-Roa (Gesneriaceae), a new solitary-flowered species from southern Mexico and Guatemala, is described and illustrated. It has been collected principally in Chiapas, Mexico, with only one location in the Sierra de los Cuchumatenes, Guatemala. Although the possession of solitary flowers is considered unusual in *Moussonia* Regel, an increase in the number of species both validly published and undescribed with this condition indicates the opposite. The combination of characteristics that distinguish the new species from other solitary-flowered species are principally the whitish strigose indumentum; the shallowly serrated and revolute leaves; the flat adaxial and abaxial surface of the leaves, adaxial surface green, abaxial surface reddish; and flowers with thick, narrow, slightly ventricose, and gradually widening tubular corollas. A key for the solitary-flowered species of *Moussonia* is included.

Resumen. *Moussonia adpressipilosa* D. L. Denham ex Ramírez-Roa (Gesneriaceae) es una nueva especie de flores solitarias del sur de México y Guatemala, que se describe e ilustra. Ha sido colectada principalmente en Chiapas, México y en una sola localidad en la sierra de los Cuchumatenes, Guatemala. Aunque la presencia de flores solitarias es considerada poco común en *Moussonia* Regel, el aumento en el número de especies tanto validamente publicadas como no descritas aún con esta condición, indica lo contrario. Las características que distinguen a la nueva especies de otras de flores solitarias son principalmente el indumento estrigoso blanquecino, hoja ligeramente aserradas y revoluta, haz y envés planos, haz verde, envés rojizo y flores tubulares gruesa, angosta, ligeramente ventricosa y gradualmente ensanchada hacia el limbo. Se incluye una clave de identificación para las especies de *Moussonia* con flores solitarias.

Key words: Gesneriaceae, Guatemala, Mexico, *Moussonia*.

Moussonia Regel is a Neotropical genus of Gesneriaceae distributed from northern Mexico (Sonora, Durango, Querétaro, and San Luis Potosí) to Panama, with 11 species (Wiehler, 1983). It was previously treated as a section of the closely related *Kohleria* Regel, but Wiehler (1975) recognized the genus and transferred 11 species into *Moussonia* from *Kohleria* sect. *Moussonia* (Regel) Fritsch. Kvist and Skog (1992), in their revision of the genus *Kohleria*, mentioned 12 species of *Moussonia*. Burtt and Wiehler (1995) published the most recent classification of the Gesneriaceae, and they recognized *Moussonia* as a genus with 11 species. The present paper is part of a revision of the genus *Moussonia*, as a doctoral thesis, and I currently estimate that there are about 24 species in the genus, some of them new.

Solitary flowers in *Moussonia* are considered to have arisen through the reduction of cymes (Wiehler, 1983), a hypothesis that is supported by the presence of a pair of bracts on the pedicel. Morton (1967: 73) stated that this condition is aberrant and contradictory in *Moussonia*. However, I have observed this condition in several species, such as *M. ampla* L. E. Skog, *M. fruticosa* (Brandegee) Wiehler, *M. rupicola* (Standley & L. O. Williams) Wiehler, *M. serrulata* (C. V. Morton) Wiehler, *M. viminalis* (Brandegee) Wiehler, and at least three undescribed taxa. Additionally, the condition of solitary flowers or inflorescence pattern, features of the leaves such as the pattern of venation, trichome type, presence of domes on the abaxial leaf surface, as well as other features of the calyx and corolla, are all useful taxonomic characters to distinguish species in *Moussonia* (Ramírez-Roa & Varela, in prep.).

Despite being represented by a limited number of collections, the description of the new species from Mexico, *Moussonia adpressipilosa*, is supported based on the morphological characters previously mentioned.

Moussonia adpressipilosa D. L. Denham ex Ramírez-Roa, sp. nov. TYPE: Mexico. Chiapas: Km 19, Colonia Cuahutemoc, Mpio. La Trinitaria, *A. Shilom Ton 8148* (holotype, MEXU-663939; isotype, MO). Figure 1.

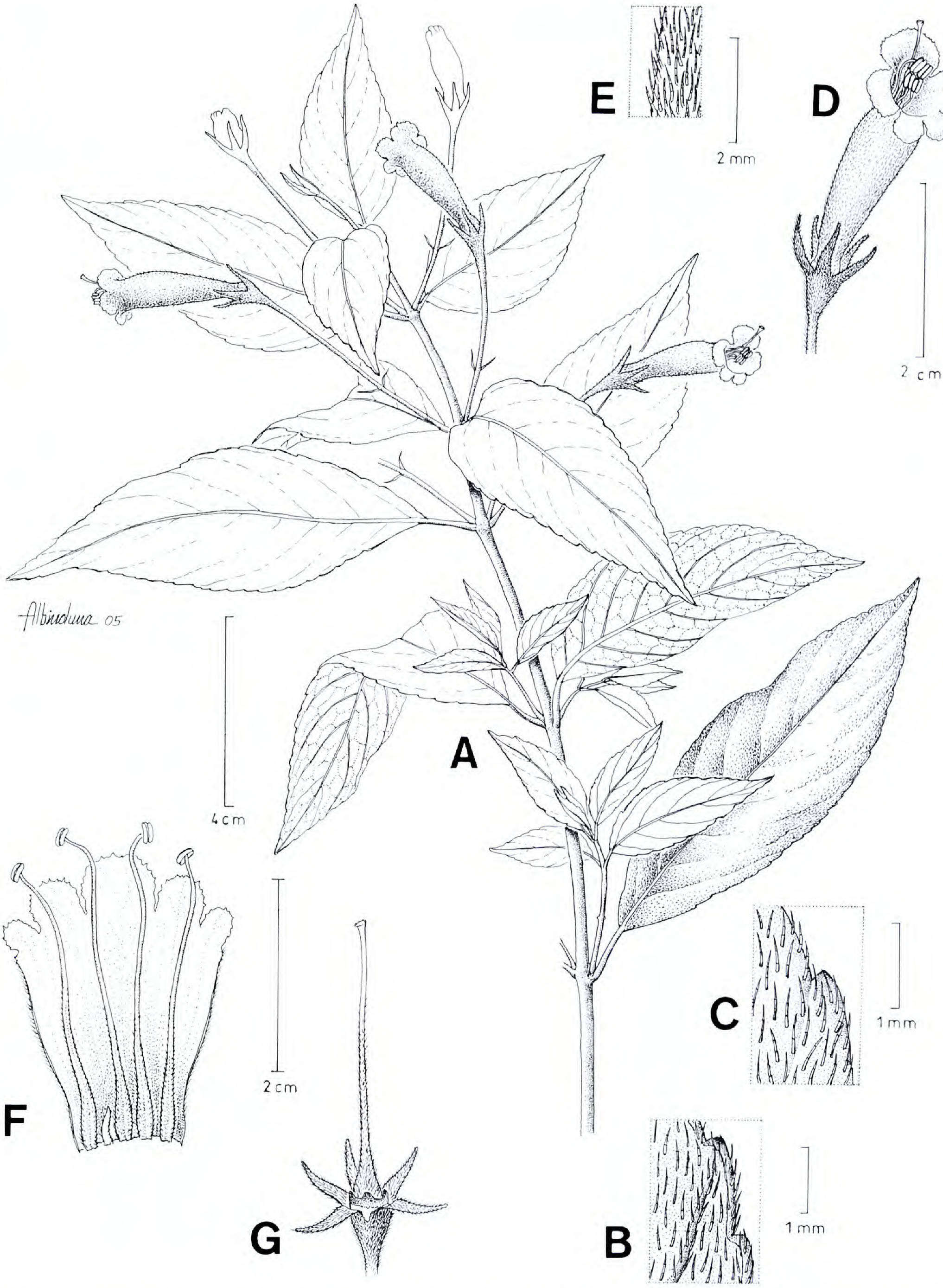

Figure 1. *Moussonia adpressipilosa* D. L. Denham ex Ramírez-Roa. —A. Habit. —B. Abaxial leaf surface. —C. Adaxial leaf surface. —D. Flower. —E. Surface of corolla tube. —F. Stamens and staminode. —G. Pistil and glandular disc. A (leaves)–C drawn from *Miranda 6192*; A (flowers), D–G drawn from *Shilom Tom 8148*.

Moussoniae fruticosae (Brandegee) Wiehler affinis, sed differt indumento strigoso albido plantam totam obtegenti, pedicello calycis basem versus amplificanti, tubo calycino turbinato-triangulari, lobis subulatis, venis indistinctis, sinubus plus minusve rotundatis, corolla tubulari fere recta, angusta, vix ventricosa, gradatim dilatata, non translucenti.

Shrub, 0.8–1.2 m tall; stems slender, branched above the base, terete, the basal woody stems reddish with sparse white strigose pubescence, the new growth greenish, densely white strigose; base of each trichome lacking a multicellular ring of epidermic cells;

stem surfaces with small, elliptic, red spots; nodes with a pair of evident, circular, shiny, reddish, fleshy dots at the base of petioles. Leaves opposite, those of a pair mostly unequal, the smaller 4.3–6 × 1.6–3.2 cm, the larger to 4.9–9.5 × 2.3–3.5 cm; petiole 5–8(19) mm, with pubescence as in the stem; blades elliptic, slightly oblique, crustaceous, light silvery green or reddish green abaxially, darker green adaxially, with pubescence as in the stem; margin lightly revolute, shallowly serrate, with cunonioid tooth, with 15 to 22 hydathode-tipped teeth on each side, sinuses rounded, apex of tooth acuminate; venation pinnate, primary vein slightly curved, not impressed adaxially, conspicuous abaxially, strigose adaxially; secondary veins semi-craspedodromous, proximal portion of the blade more acute than distal portion, 6 to 8 pairs, tertiary venation transverse; abaxial blade surface flat, slightly strigose, stomata evident, apparently without domes. Flowers solitary in the axils of new growth, rarely 2 on the same peduncle, peduncle slender, 0.7–2.5 cm long, with 2 filiform bracts 3–3.5 × 0.16–0.5 mm; pedicel 1.7–2.4(–4) cm, enlarged at the apex below the floral tube, the entire flower stalk with pubescence and spots as on the stems. Calyx tube turbinate-triangular, densely white appressed-villose throughout, 3–4 × 2.5–3 mm, lobes subulate, abruptly tapering, spreading, 4–8(9) × 1.3–2 mm, margin entire, generally slightly concave at the base of one side and slightly convex at the base of the other side, sinus almost rounded, veins obscured by the trichomes; corolla tubular, straight, narrow, lightly ventricose and gradually widening, thick, red to red-orange, densely strigose, except for the glabrous ventral and dorsal portions of the limb that are covered by the lateral lobes in bud, cylindric trichomes with some septa filled with anthocyanins; corolla tube 2.2–2.8 cm, broader at the base (0.45–0.61 cm), throat 7.5–9 mm wide, limb 1–1.3 cm wide, dorsal and lateral lobes ovate, 4.5–5 × 5–6 mm, ventral lobe 3.5–4 × 3.5–4 mm, lateral lobes intermediate in size and shape, red with spots and lines near the throat and lobes; stamens 4, didynamous, inserted; dorsal staminode 3.2 mm; filaments slender, slightly puberulent, widening near the base, free, densely red villous, curved at the apex, not swollen terminally near the connective; anthers rectangular, with longitudinal dehiscence, coherent, 1.5 × 1.2 mm, mid-dorsal side of the anthers bearing small, fleshy, broad prolongations; nectary represented by a low annular ring with 5 triangular glands, to ca. 0.7 mm high at the glands, 0.5 mm high at the ring, densely velutinous with acroscopic trichomes; ovary half-inferior, the free portion densely velutinous like the nectary; style slender, 2 cm, apex slightly curved and thickened, puberulous, with minutely glandular trichomes; stigma narrowly stomatomorphic. Fruit a dry capsule, ovoid, apex conic, dehiscing apically and loculicidally into 2 valves, brownish green, 8–10 × 4.4–5.5 mm, white appressed-villous; seeds numerous, yellow-brown, 0.15–0.2 × less than 0.1 mm.

Distribution, habitat, and phenology. Endemic to Mexico and Guatemala, *Moussonia adpressipilosa* is known from Chiapas, Mexico, and the Sierra de los Cuchumatanes, Guatemala, where it grows in montane rainforest, sometimes mixed with oak–pine forest or in steep rocky wet forest in ravines, at elevations from 550 to 1300 m. Collections with flowers have been made in May and August. Collections with fruits have been made in May and July.

Etymology. The epithet "adpressipilosa" refers to the dense strigose indumentum, which covers virtually the entire above-ground portion of the plant.

This species is recognized by the white strigose pubescence of the plant and flowers; the shallowly serrate and revolute leaf margin; the flat abaxial surface of the leaves with visible stomata, apparently without domes; the leaf blade light silvery green or reddish green abaxially, dark green adaxially; the flowers with thick, narrow, slightly ventricose, and gradually widening tubular corollas; and the calyx with a turbinate-triangular tube, white appressed-villous surface, and subulate lobes abruptly tapering, with almost rounded sinus.

Some of the specimens included here were previously identified either as the closely related *Moussonia fruticosa* or as *M. elegans* Decaisne. The type specimen itself was included in *M. elegans*. This species was first recognized as distinct by Dale L. Denham, from the University of Colorado Museum. He labeled the type specimen in 1971 as *Moussonia adpressipilosa*, but unfortunately he never formally published the species. His notes and a preliminary description were kindly provided to me by his wife, Miriam Denham, and this information was very useful in the preparation of this paper. *Moussonia fruticosa* differs from *M. adpressipilosa* by the narrow, elliptic leaves with the adaxial surface glabrous but ciliate, the pedicel not enlarged at the apex below the floral tube, the evidently thin and lightly pubescent corolla with spreading corolla lobes, the narrowly turbinate calyx tube, linear-triangular calyx lobes that are straight at the base, and acute sinuses. *Moussonia elegans* differs in many aspects, but principally it is distinguished by having villous pubescence and an umbellate inflorescence with four flowers.

Although the character is present in other species of the genus, this is the first published report of the circular, shiny, reddish, and fleshy dots at the base of

the petioles. An anatomical study of this character is underway by Ramírez-Roa and Terrazas (in prep.). This is also the first report of the type of veins and teeth of the margin of the leaves, which are described according to Dilcher (1974) and Hickey and Wolfe (1975).

The following key includes the solitary-flowered species of *Moussonia*.

Key to the Species of *Moussonia* with Solitary Flowers

1a. Calyx lobes dentate; corolla thin . . . . . *M. ampla*
1b. Calyx lobes entire; corolla thin or thick.
  2a. Adaxial surface of the leaves papillose; base of each trichome with a multicellular ring of epidermal cells.
    3a. Corolla estrigose; calyx lobes linear-subulate . . . . . *M. rupicola*
    3b. Corolla pilose; calyx lobes lanceolate-triangular . . . . . *M. serrulata*
  2b. Adaxial surface of the leaves flat; base of each trichome (if present) lacking a multicellular ring of epidermal cells.
    4a. Calyx tube narrowly turbinate; corolla slightly pubescent; leaves glabrous, ciliated.
      5a. Calyx lobes with 3 visible veins; leaf margin setose . . . . . *M. fruticosa*
      5b. Calyx lobes without visible veins; leaf margin pilose . . . . . *M. viminalis*
    4b. Calyx tube turbinate-triangular; corolla densely strigose; leaves white strigose throughout . . . . . *M. adpressipilosa*

The extent of morphological variation in *Moussonia adpressipilosa* is not evident because there is very little material available for study. However, the size of the marginal teeth of the leaves and the size of the calyx lobes vary. Also, one specimen from pine–oak forest (*Cabrera et al., 1856*) has in one node two flowers on one common peduncle.

Conservation status. It should be noted that all the collections of *Moussonia adpressipilosa* in Mexico were made in the 1970s or 1980s from vegetation that had been severely affected by human activity and thus with conservation problems (the specimen from Guatemala was collected in 1942). Field studies are required to ascertain if this species still exists in the wild or if it has become extinct. Among this Mexican Gesneriaceae, one species of *Achimenes* Persoon may already be extinct; this is *A. brevifolia* C. V. Morton, a taxon known only from the type collection made by Hinton in 1937 (Ramirez-Roa, 1987). It is hoped that *M. adpressipilosa* will not follow.

Paratypes. GUATEMALA. **Dept. Huehuetenango:** Vic. Maxbal, ca. 17 mi. N of Barillas, Sierra de los Cuchumatanes, *J. A. Steyermark 48862* (US). MEXICO. **Chiapas:** E of Laguna Tzikaw, Montebello Park, Mpio. La Trinitaria, *D. E. Breedlove 35245* (DS, MEXU, MO); 70 km SW of Palenque to Ocosingo along Jol Uk'um, Mpio. Ocosingo, *D. E. Breedlove 52509* (CAS, LL, MEXU, MO); 15 km al E de las Lagunas de Monte Bello, *E. Cabrera, E. Martínez y H. de Cabrera 1856* (MEXU, US); Montebello-Tziscao, 5 abril 1950, *F. Miranda 6192*.

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Note on *Astragalus* sect. *Incani* (Fabaceae) in Iran

Massoud Ranjbar

Department of Biology, Herbarium Division, Bu-Ali Sina University, P.O. Box 65175/4111, Hamadan, Iran. ranjbar@basu.ac.ir

Abstract. *Astragalus hashtrudicus* Ranjbar, a single new species endemic to Iran, is described and illustrated. The new species belongs to subgenus *Cercidothrix* Bunge, section *Incani* DC., in *Astragalus* L. and seems to be distinct among the Iranian species. *Astragalus hashtrudicus* is distributed in northwestern Iran in the Azarbaijan Sharqi province. It is closely related to *A. priliphoanus* Grossheim and is distinguished by its pods that are rather densely covered with appressed white trichomes and its leaflets that lack minute dark reddish dots. The conservation status is evaluated as VU (Vulnerable) according to IUCN criteria.

Key words: *Astragalus*, subgenus *Cercidothrix*, Fabaceae, Iran, IUCN Red List, section *Incani*.

In terms of species number, *Astragalus* L. (Fabaceae) may be the largest genus of vascular plants, represented by a total of ca. 2500 taxa (Lock & Simpson, 1991; Mabberley, 1997; Maassoumi, 1998; Ranjbar & Karamian, 2002). *Astragalus* is the most speciose genus in Iran, and section *Incani* DC. (subgenus *Cercidothrix* Bunge) is one of its largest sections, with ca. 70 species in Iran (Ranjbar & Karamian, 2003; Podlech & Maassoumi, 2003; Ranjbar et al., 2005; Ranjbar & Rahiminejad, 2005) and ca. 120 species in the world (Lock & Simpson, 1991; Yakovlev et al., 1996).

While investigating *Astragalus* sect. *Incani* in the mountains of Iran, I found a single peculiar population of it that differed from other species described from section *Incani* in Iran.

Astragalus hashtrudicus Ranjbar, sp. nov. TYPE: Iran. Azarbaijan Sharqi: Maragheh to Hashtrud, 65 km subalpine near Hashtrud, 1700 m, 8 June 2004, *M. Assadi & M. Ranjbar 6103* (holotype, TARI; isotypes, Bu-Ali Sina University Herbarium, herb. *M. Ranjbar*, MO). Figure 1.

Astragalo priliphoano Grossheim affinis sed foliis 15–30 (nec 10–14) cm longis, pedunculo 45–60 (nec 15–40) cm longo, utrinque non minute atro-purpureo-punctatis (nec utrinque minute atro-purpureo-punctatis), leguminibus pilis saepissime mere albis (nec albis atque nigris) obtectis differt.

Plants to 60 cm tall, densely pubescent with appressed, ± symmetrically medifixed, mostly white trichomes, 0.3–0.8 mm; caudex to 10 mm diam., mostly with a pluricipital root crown, branches short, thick, covered with blackish remnants of old stipules and petioles. Stipules 7–12 × 4–5 mm, triangular-acuminate, adnate to the petiole for 2.5–3 mm, densely pubescent; leaves 15–30 cm; petiole 7–18 cm, striate, 1–2 mm thick, ± white pubescent, leaflets in 7 to 13 pairs, elliptic to broadly elliptic or rarely ovate, round-tipped and mucronulate, 8–25 × 4–13 mm, on both sides ± pubescent, not spotted with minute dark reddish dots. Peduncles 45–60 cm, to 4 mm thick, angular-sulcate, densely pubescent; racemes densely 23- to 50-flowered, in fruit mostly strongly elongated, to 25 cm long; bracts linear to narrowly triangular, 2–4 × 1–1.5 mm, glabrous, ciliate or sometimes with a few black and white trichomes. Pedicels 1–2 mm; flowers erect to rarely spreading; bracteoles ca. 0.8 mm; calyx 7–9.5 mm, tubular, slightly gibbous at base, oblique, ± densely covered with medifixed, appressed black trichomes (0.3–0.6 mm) with rarely a few white trichomes mixed in; calyx teeth narrowly linear to minutely triangular, 0.8–1 mm; corolla violet, standard 22–24 mm, limb 8–9 mm wide, elliptic, narrowed into a long tongue-like appendix, to 4 mm wide, rounded at tip, gradually narrowed into a short claw, wings 18–19 mm; limbs oblong, 9–10 × 2.5–3 mm, auricle very short, keel 14–15 mm; blades obliquely oblong, with slightly curved lower edge and nearly straight upper edge, obtuse at the apex, 5–6 × 2–3 mm; claw 9–10 mm. Ovary with a stipe ca. 0.5 mm, linear, appressed-pubescent; long style persistent, glabrous. Legumes sessile, erect, linear, straight, 18–23 × 3.5–5 mm, with an oblique beak to 4 mm, bilocular; valves pale greenish brown, rather densely covered with medifixed, appressed exclusively white trichomes (0.4–0.8 mm); seeds rectangular-reniform, (2–)2.5–4 × 1–1.5 mm, brown to blackish.

Etymology. The species is named after the type locality, Hashtrud, in Azarbaijan Sharqi province, Iran.

Phenology. Flowering occurs in May and June; fruit ripening occurs from June to August.

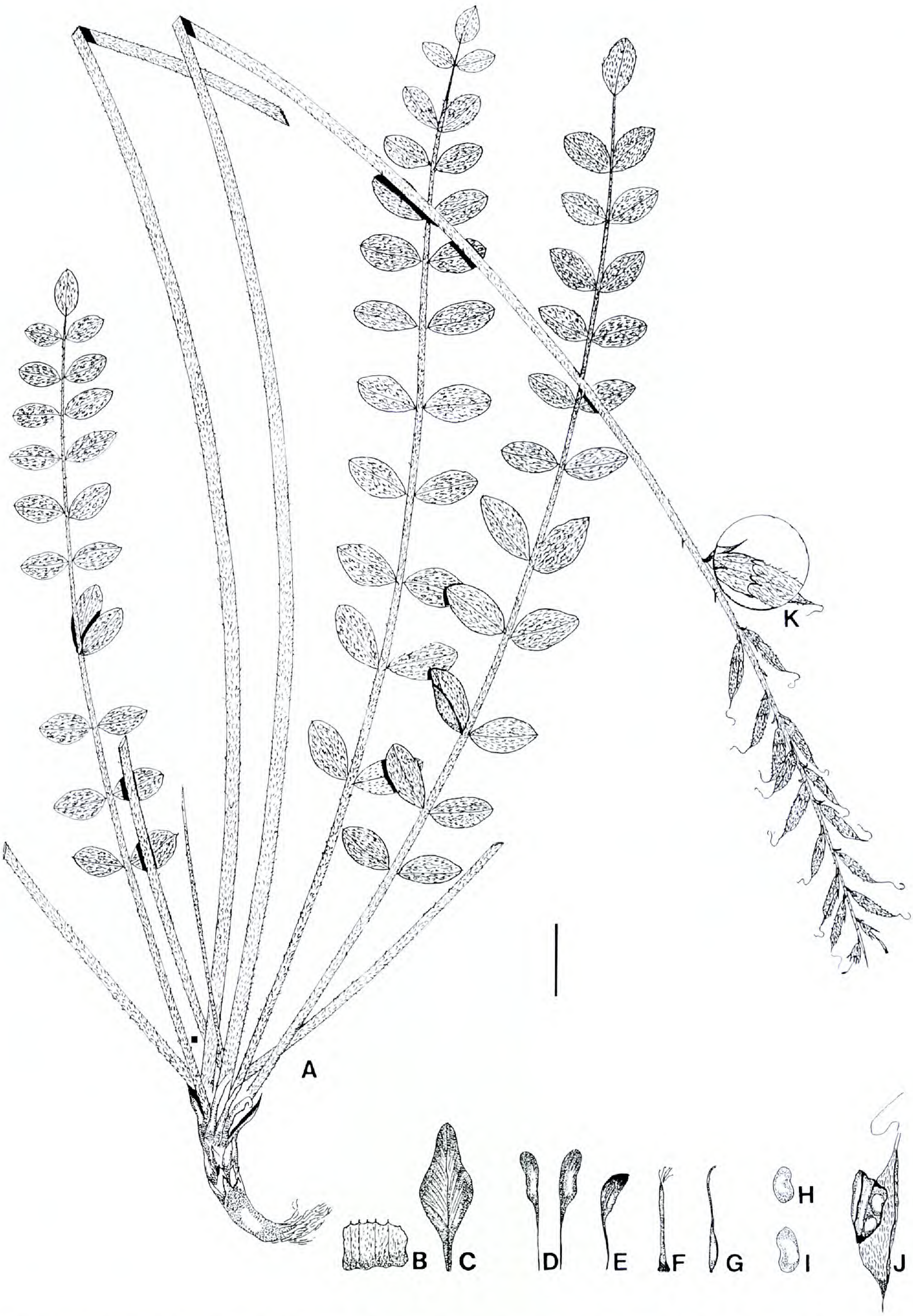

Figure 1. *Astragalus hashtrudicus* Ranjbar. —A. Habit with details of flower and pod. —B. Calyx. —C. Standard. —D. Wings. —E. Keel. —F. Androecium. —G. Pistil. —H, I. Seed. —J. Seed in pod. —K. Magnified view of pod and calyx. Drawn from the holotype *Ranjbar 6103* (TARI). Scale bar: A = 2 cm; B–K = 1 cm.

Table 1. Diagnostic morphological characters of *Astragalus hashtrudicus* and *A. prilipkoanus*.

	A. hashtrudicus	*A. prilipkoanus*
Leaflets	leaflets without minute dark red dots	leaflets with minute dark red dots
Leaf length (cm)	15–30	10–14
Petiole (cm)	7–18	3–5
Peduncle (cm)	≤ 60	≤ 20(–40)
Calyx teeth (mm)	0.8–1	1–2
Pod indumentum	± densely pubescent with appressed white trichomes only	loosely to subdensely ± pubescent with appressed white and scattered black trichomes

Distribution and habitat. *Astragalus hashtrudicus* was seen in the field by the author and is known from five specimens from the type locality that are deposited at the herbarium of Bu-Ali Sina University. The new species occurs in Azarbaijan Sharqi province. It is endemic to northwestern Iran and known only from the type locality. It was collected from the dry steppe and clay zones along the roadside of the Sahand Mountains.

IUCN Red List category. I observed a very low frequency of the new species in one field locality and therefore have decided to classify this species as VU (Vulnerable), a category that includes taxa with small populations that could be at risk, according to IUCN criteria (IUCN, 2001). My interpretation is based on a single known population.

Taxonomic discussion. This new species is closely related to *Astragalus prilipkoanus* Grossheim, especially by its similar indumentum, number of leaflets, and shape, size, and arrangement of pods (Table 1).

Key to the Species of the *Astragalus prilipkoanus* Group

1a. Peduncle up to 60 cm, leaves 15–30 cm, pods ± densely covered with appressed exclusively white trichomes, leaflets not spotted with minute dark red dots . . . . . *A. hashtrudicus*

1b. Peduncle up to 15(–40) cm, leaves 10–14 cm, pods ± densely covered with appressed white and black trichomes, leaflets spotted with minute dark red dots . . . . . *A. prilipkoanus*

Acknowledgments. The great help of Ernst Vitec, Bruno Wallonofer, and Walter Till during my visit to W and WU in Vienna is much appreciated. I am grateful to Victoria Hollowell and Beth Parada (MO) for revising the manuscript, as well as for their useful comments and suggestions. This project has received financial support from the Bu-Ali Sina University (project no. 32-3686 "Cytotaxonomical study of *Astragalus* sect. *Incani* in the western part of Iran"). I thank the Director of the Herbarium of Ferdowsi University of Mashhad (FUMH), and the Herbarium Research Centers of Natural Resources and Animal Affairs of Esfahan, Kashan, Kerman, Mashhad, Semnan, Shiraz, and Tabriz for making the herbarium facilities available for my study. I also thank Ali Moradi for preparing the illustrations.

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A New Species, *Habranthus sanavirone* (Amaryllidaceae), from Argentina

Germán Roitman,[1] *José A. Castillo,*[2] *Graciela M. Tourn,*[3] *and Rolando Uria*[1]

[1] Cátedra de Jardinería, Facultad de Agronomía, Universidad de Buenos Aires, Av. San Martin 4453, 1417 Buenos Aires, Argentina. roitman@mail.agro.uba.ar

[2] Jardín Botánico de Ezeiza, Jujuy 1037, 1804, Ezeiza, Prov. de Buenos Aires, Argentina. ezeizabotgard@hotmail.com

[3] Cátedra de Botánica Agrícola, Facultad de Agronomía, Universidad de Buenos Aires, Av. San Martin 4453, 1417 Buenos Aires, Argentina

ABSTRACT. A new species of *Habranthus* Herbert (Amaryllidaceae) is described and illustrated. *Habranthus sanavirone* Roitman, J. A. Castillo, G. Tourn & Uria is found in sandy soils of central Argentina. The new species resembles *H. robustus* Herbert in size but can be easily distinguished by the absence of bulblets, its glaucous leaves, and its recurved light yellow tepals, with this feature not found in any other species of the genus.

Key words: Amaryllidaceae, Argentina, *Habranthus*, IUCN Red List.

Habranthus Herbert is an American genus of Amaryllidaceae with ca. 25 to 35 species (Herbert, 1837; Baker, 1888; Sealy, 1937; Arroyo-Leuenberger, 1996) that are primarily from Argentina, Chile, southern Brazil, Bolivia, Paraguay, and Uruguay; however, five of these species are from Mexico and one is from the United States (*Habranthus tubispathus* (L'Héritier) Traub, probably introduced from South America). *Habranthus* belongs to the tribe Zephyrantheae (Traub, 1963), but Meerow et al. (1999) classified *Habranthus* in tribe Hippeastreae based on phylogenetic relationships. Additionally, Meerow et al. (2000) presented cladograms that showed *Zephyranthes* Herbert and *Haylockia* Herbert as sister genera to *Habranthus*.

During a trip to the province of Córdoba, Argentina, we found a new species of *Habranthus* that is remarkable by the size, shape, and color of the flowers. Bulbs collected in the field were cultivated in the J. O. Hall Garden facilities (Facultad de Agronomía, Universidad de Buenos Aires). We made observations about the growth and phenology of the new species during a four-year period.

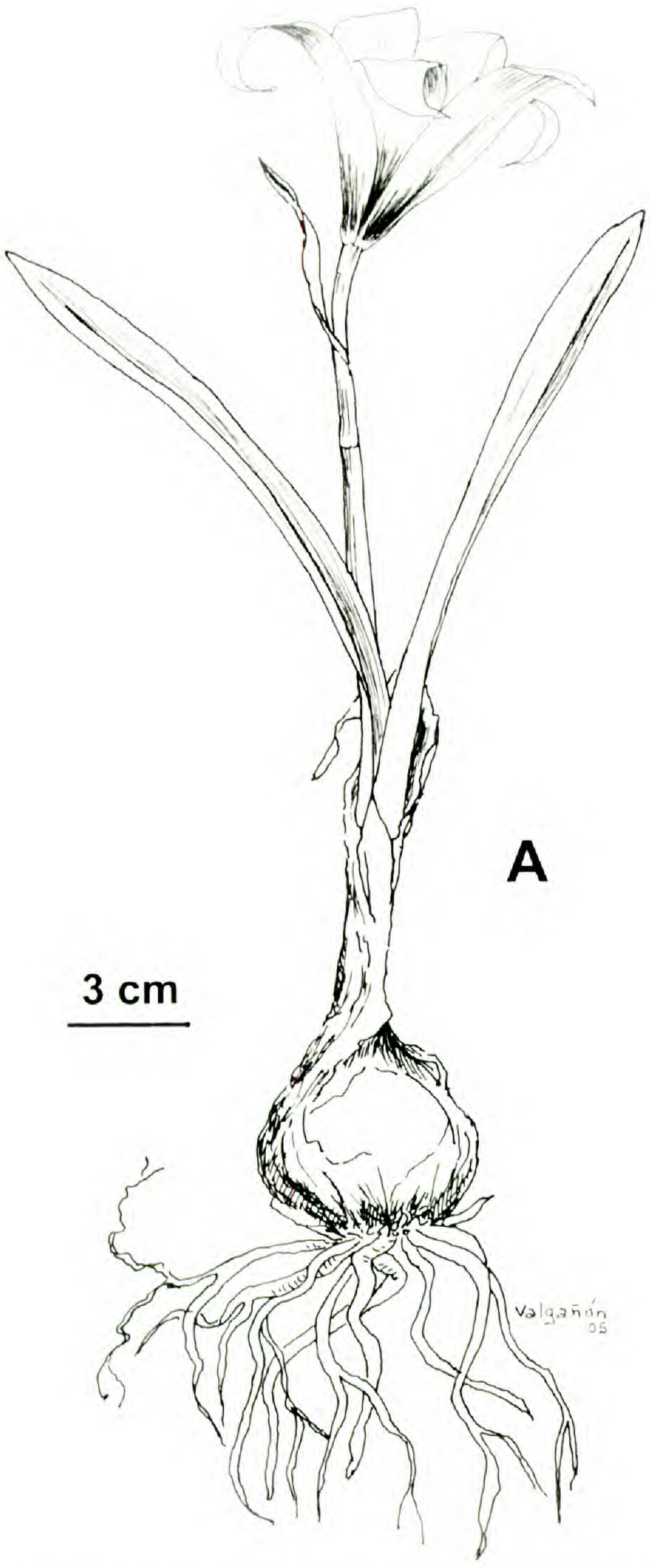
Habranthus sanavirone Roitman, J. A. Castillo, G. Tourn & Uria, sp. nov. TYPE: Argentina. Córdoba: San Marcos Sierra, 27 Nov. 2002, *G. Roitman & G. M. Tourn s.n.* (holotype, BAA 25415). Figure 1.

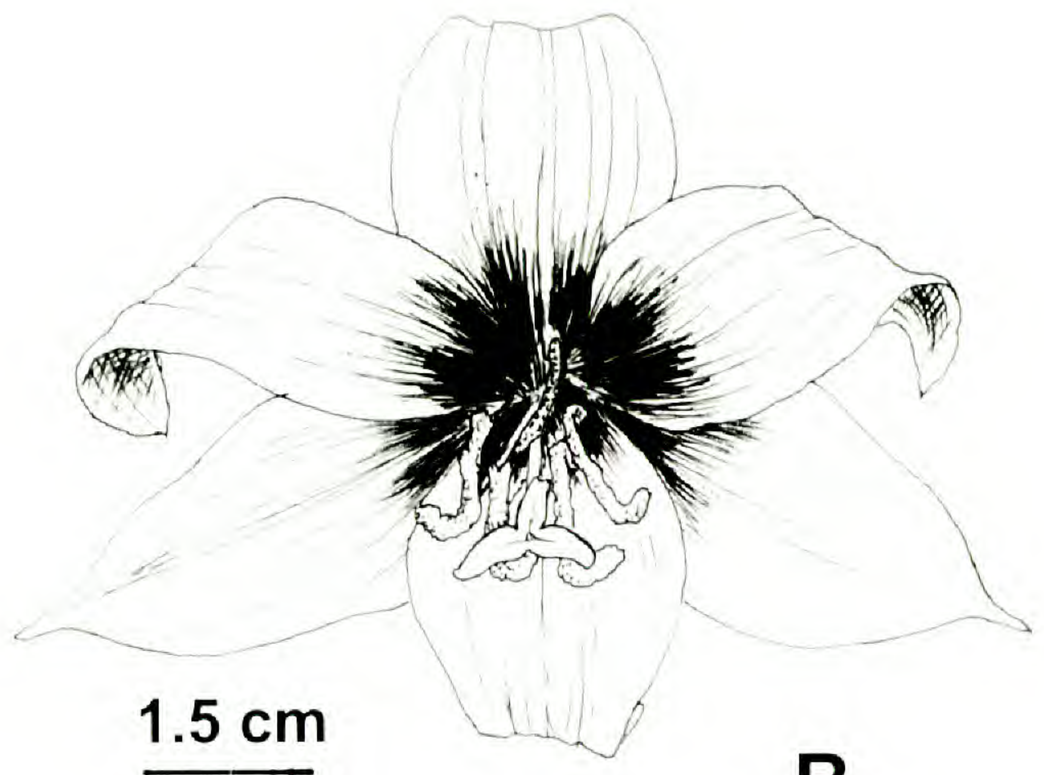
Ab *Habrantho robusto* Herbert foliis basalibus glaucis viridibus, ad anthesin praesentibus, 18–22 × 0.8–1.2 cm, floribus lutescentibus, ad 82 mm, tepaliis ad apicem recurvatis differt.

Plant 25–30 cm; bulb ovoid, 40–45 × 37–45 mm, prolonged into a neck; outer coats dark brown. Leaves present at anthesis, linear, 18–22 × 0.8–1.2 cm, glaucous green. Scape 12–15 cm × 3 mm; spathe with 1 flower, membranous, tubular basally for 30 mm, then bifid apically for 23 mm; peduncle (not branched) to 55–65 mm. Flower light yellow, 82 mm, with darker distal edges and dark red outside basally. Tepals oblanceolate, joined at the base for 5 mm, recurved toward apex, the outer tepals 71 × 15 mm, the inner ones 68 × 11 mm; stamens with filaments fascicled-declined, rather incurved above; upper episepalous filaments 15 mm, lateral episepalous filaments 18 mm, lateral epipetalous filaments 20 mm, and lower epipetalous filaments 23 mm; anthers markedly falcate after the release of pollen, 8 mm; style declined, ca. 35 mm; stigma trifid, its divisions obliquely spreading at first, then recurved, ca. 6 mm; ovary elliptic-oblong, ca. 11 × 5 mm. Fruits and seeds not seen.

Habranthus sanavirone is similar in the size of the flowers to *H. robustus* Herbert (to 40–70 mm) but is distinguished by its light yellow flowers with darker bases (vs. pink flowers), its recurved tepals, and the absence of bulblets (vs. presence of bulblets). The distribution of these two species is completely different. *Habranthus robustus* inhabits southeastern Brazil, while *H. sanavirone* is endemic to the hills close to San Marcos in central Argentina. The specific epithet is taken from the indigenous tribe, the Sanavirones, that used to inhabit this area in the province of Córdoba.

Distribution, habitat, and IUCN Red List category. Habranthus sanavirone is known only from the hills near San Marcos Sierra, province of Córdoba in Argentina. It inhabits sandy soils in open areas close to *Schinopsis marginata* Engler forest. During the past three years, we have observed scattered individuals at altitudes between 700 and 900 m in a very restricted area near the type





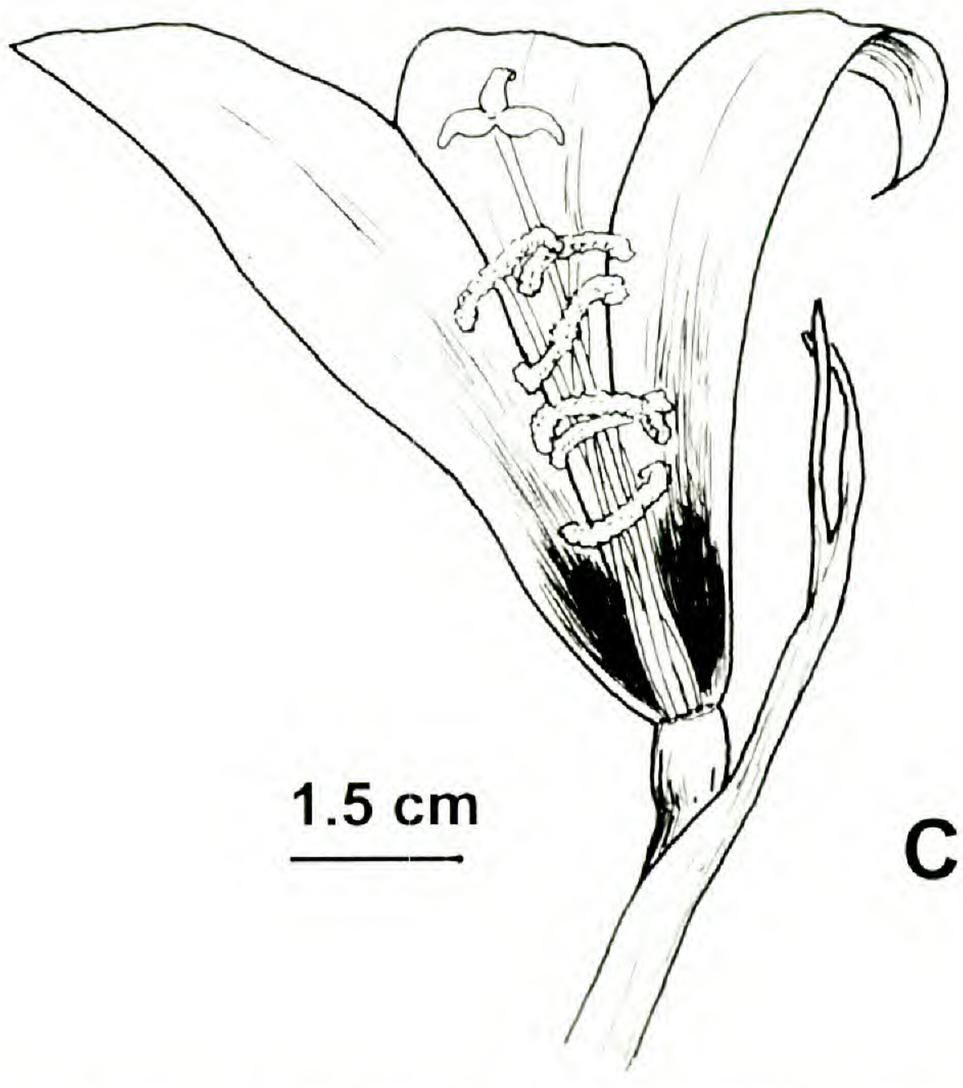


Figure 1. *Habranthus sanavirone* Roitman, J. A. Castillo, G. Tourn & Uria. —A. Plant habit. —B. Flower view from above. —C. Flower in lateral cross section. Drawn from the holotype, *G. Roitman & G. M. Tourn s.n.* (BAA 25415).

locality in San Marcos Sierra. We conclude that the new species can be considered an endangered species (EN B2 a), according to IUCN criteria (IUCN, 2001).

Phenology. Flowering during November to January, corresponding to rainfall.

Acknowledgments. We are grateful to R. D. Tortosa for his constructive criticism on an earlier draft, Gerald L. Smith for his comments on the manuscript, and N. Valgañon for the illustration of the species.

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Generic Limits of *Dryopetalon*, *Rollinsia*, *Sibara*, and *Thelypodiopsis* (Brassicaceae), and a Synopsis of *Dryopetalon*

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri, U.S.A. 63166-0299.
Ihsan.al-shehbaz@mobot.org

Abstract. The genus *Rollinsia* Al-Shehbaz is reduced to synonymy of *Dryopetalon* A. Gray (Brassicaceae), and the characters distinguishing the latter from *Sibara* Greene and *Thelypodiopsis* Rydberg are discussed. An expanded description of *Dryopetalon* (southern United States and northern Mexico) and a key, synonymies, and distributions of its eight species are presented. The new combinations *D. breedlovei* (Rollins) Al-Shehbaz, *D. byei* (Rollins) Al-Shehbaz, *D. paysonii* (Rollins) Al-Shehbaz, and *D. viereckii* (O. E. Schulz) Al-Shehbaz are proposed. *Dryopetalon purpureum* Rollins is reduced to synonymy of *D. palmeri* (S. Watson) O. E. Schulz, and *D. crenatum* var. *racemosum* Rollins and *D. runcinatum* var. *laxiflorum* Rollins are reduced to synonymy of their respective species. *Arabis endlichii* O. E. Schulz is lectotypified.

Key words: Brassicaceae, *Dryopetalon*, Mexico, *Rollinsia*, *Sibara*, *Thelypodiopsis*, United States.

During work on the treatment of Brassicaceae for an upcoming volume of the *Flora of North America* (FNA), the morphological boundaries of several genera are critically evaluated, especially in light of available molecular data (e.g., Warwick et al., 2002, 2006) and the most recent tribal classification of the family (Al-Shehbaz et al., 2006). This action required the examination of all species of *Dryopetalon* A. Gray, *Rollinsia* Al-Shehbaz, *Sibara* Greene, and *Thelypodiopsis* Rydberg, including several that occur south of the FNA area in Mexico. The present paper focuses on the species included herein in *Dryopetalon*.

Dryopetalon

The North American *Dryopetalon* was established by Gray (1853) as a monotypic genus readily distinguished from the other genera of Brassicaceae (Cruciferae) by having lobed petals superficially resembling the leaves of certain oaks. Schulz (1929) added another species originally described as *Cardamine plameri* S. Watson, and the genus remained ditypic in Schulz's (1936) comprehensive monograph of the family. Rollins (1941, 1984) added three species, and as it stands now (Rollins, 1993; Appel & Al-Shehbaz, 2003), *Dryopetalon* consists of five species and three varieties.

Schulz (1936) placed *Dryopetalon*, along with the Chilean-Argentinean *Schizopetalon* Sims (10 species; Al-Shehbaz, 1989) and the Mexican *Ornithocarpa* Rose (two species; Rollins, 1969), in the Schizopetaleae, a tribe he delimited solely on the basis of having lobed or fimbriate petals. In their recent tribal classification of the family, Al-Shehbaz et al. (2006) placed *Ornithocarpa* in the tribe Cardamineae, maintained both *Dryopetalon* and *Schizopetalon* in the Schizopetaleae, and expanded the latter tribe to include at least 20 genera, of which 18 have entire petals.

As delimited by Rollins (1993), *Dryopetalon* shows tremendous variation in the development of the petal lateral teeth or lobes. For example, in *D. runcinatum* A. Gray, the generic type, the petals are 2- to 5-toothed or -lobed on each side, whereas in *D. palmeri* (S. Watson) O. E. Schulz they show continuous variation from being obscurely crenate to strongly laciniate at the margin, and in *D. membranifolium*

Rollins the petals are deeply emarginate at the apex and have no lateral lobes.

Studies on *Arabidopsis thaliana* (L.) Heynhold show that the loss of function in the JAGGED gene or in the sterol biosynthesis gene *FRL1* leads to the formation of toothed or serrated petals (Dinneny et al., 2004; Hase et al., 2005). These findings imply that the development of toothed petals can be controlled by simple Mendelian inheritance. It is not known if a similar genetic basis exists in *Dryopetalon*, but these mutations in *A. thaliana* should warn against the overemphasis of characters such as petal margin as the main criterion to delimit genera at the expense of the overall morphology. Several genera of the Brassicaceae encompass variation in petal morphology comparable to that of *Dryopetalon*. For example, *Draba* L. includes species with deeply 2-lobed and entire petals, whereas the Himalayan *Megacarpaea* DC. has eight species with entire petals and only one, *M. delavayi* Franchet (China), has entire or shallowly to deeply 3(or 5)-lobed petals (Zhou et al., 2001). Evidently, lobed petals evolved independently multiple times within the Brassicaceae. In delimiting *Dryopetalon*, I depend on all features of the plant and put less emphasis on the petal margin. In so doing, some of the species recognized herein have entire petals.

Thelypodiopsis

Schulz (1936) placed *Thelypodiopsis* (western United States, northern Mexico) in the tribe Hesperideae and *Dryopetalon* in the Schizopetaleae, whereas Al-Shehbaz et al. (2006) place both genera in the latter tribe. Indeed, the similarities between some species currently assigned to the two genera are so substantial that there is some justification to Rollins' (1984: 22) statement: "There is such a close resemblance between *D. membranifolium* and those of *Thelypodiopsis byei* and *T. breedlovei*, both of which have entire petals, that it is among these species where *Thelypodiopsis* and *Dryopetalon*, as genera, come close together." In the absence of flowering material, Rollins (1982b) indicated that it is almost impossible to reliably assign specimens of the above three species to genera. However, despite the overwhelming similarities in all other characters, he depended solely on the petal margin and apex in the generic disposition of these species.

Rollins (1976, 1982b, 1984) gradually expanded the limits of *Thelypodiopsis* well beyond the original delimitation proposed by Rydberg (1907) and later refined by Al-Shehbaz (1973). Of the 17 species recognized by Rollins (1993) in *Thelypodiopsis*, only seven (*T. ambigua* (S. Watson) Al-Shehbaz, *T. aurea* (Eastwood) Rydberg, *T. divaricata* (Rollins) S. L. Welsh & Reveal, *T. elegans* (M. E. Jones) Rydberg, *T. juniperorum* (Payson) Rydberg, *T. vermicularis* (S. L. Welsh & Reveal) Rollins, and *T. wootonii* (B. L. Robinson) Rollins) are retained by the present author in this genus. Both *T. breedlovei* Rollins and *T. byei* Rollins are transferred herein to *Dryopetalon*, whereas *T. alpina* (Standley & Steyermark) Rollins is retained in *Romanschulzia* O. E. Schulz, and the remaining seven species are being studied for placement in a fourth genus.

As delimited by Al-Shehbaz (1973), *Thelypodiopsis* includes species with prominently 2-lobed stigmas, linear anthers 2.5–4 mm long, distinct gynophores up to 9 mm long, and oblanceolate petal claws well differentiated from the blade. Both *T. breedlovei* and *T. byei*, as well as all *Dryopetalon*, have subentire or only obscurely lobed stigmas, ovate to oblong anthers rarely exceeding 1 mm in length, often obsolete gynophore, and petals often undifferentiated into blade and claw or gradually attenuated into a claw-like base.

Rollinsia

Rollinsia was recognized by Al-Shehbaz (1982) as a monotypic genus based on a species originally described by Rollins (1957) as *Thelypodium paysonii* Rollins. The characters used to distinguish *Rollinsia* from *Thelypodium* Endlicher are the presence in *Rollinsia* of pubescent (vs. glabrous) bases of filaments and petal claws, non-torulose (vs. torulose) fruits, and a chromosome number of $2n = 20$ (vs. $2n = 26$). All of the above features of *Rollinsia* are present in *Dryopetalon*, especially *D. crenatum* (Brandegee) Rollins and *D. runcinatum*, both of which also have pubescent filament and petal bases, and *D. palmeri*, which has non-torulose fruits and slender gynophores. The original illustration of *T. paysonii* (Rollins, 1957: 63; duplicated in Rollins, 1993: 723) correctly shows the petals to have undulate or few-toothed margins, but this aspect of the species was overlooked. Indeed, in the absence of petals, it is virtually impossible to distinguish *T. paysonii* from species of *Dryopetalon*. Only *D. runcinatum* is known cytologically, and its $2n = 24$ (Warwick & Al-Shehbaz, 2006) represents a higher aneuploid number than that of *T. paysonii*. The latter species is transferred herein to *Dryopetalon*, and *Rollinsia* is consequently reduced to synonymy.

Sibara

Although one of the six species initially assigned by Greene (1896) in *Sibara* is *Dryopetalon palmeri*, the remaining five species were maintained in *Sibara* by Schulz (1936), and the genus was expanded by Rollins (1947, 1982a) to include 10 species.

As later circumscribed by Rollins (1993), *Sibara* (southern United States, northern Mexico) represents a heterogeneous assemblage of 10 species currently assigned to four genera of two tribes. *Sibara virginica* (L.) Rollins is now recognized in *Planodes* Greene, a genus placed by Schulz (1936) in the tribe Arabideae and by Al-Shehbaz et al. (2006) in the tribe Cardamineae. Of the remaining nine species that belong to the Schizopetaleae, six are maintained by the present author in *Sibara*: *S. angelorum* (S. Watson) Greene, *S. brandegeana* (Rose) Greene, *S. deserti* (M. E. Jones) Rollins, *S. filifolia* (Greene) Greene, *S. laxa* (S. Watson) Greene, and *S. mexicana* (S. Watson) Rollins. One species, *S. grisea* Rollins, is a synonym of *Thelypodium texanum* (Cory) Rollins and will be treated as such for the FNA. Of the remaining two species, I have not seen any material of *S. mexicana*, a species known only from the type specimen. However, I have examined numerous collections of *S. viereckii* (O. E. Schulz) Rollins, and this species is transferred herein to *Dryopetalon*.

Sibara is readily distinguished from the other North American genera of Brassicaceae by having very lax flowering racemes and pectinate or deeply pinnatisect leaves with filiform to narrowly linear lobes. *Dryopetalon* has dense, corymbose, flowering racemes and entire or runcinate to pinnatifid lower leaves with broad lobes. Almost all species of *Dryopetalon* are long-pilose or hirsute at the base of the stem, and the plants are never glaucous. By contrast, species of *Sibara* are glaucous and either glabrous throughout or puberulent with minute simple or forked trichomes.

An expanded description of *Dryopetalon*, as well as a key, enumeration, synonymies, and distributions of its species are provided below.

Dryopetalon A. Gray, Smithsonian Contr. Knowl. 5: 11. 1853. TYPE: *Dryopetalon runcinatum* A. Gray.

Rollinsia Al-Shehbaz, Taxon 31: 422. 1982. TYPE: *Rollinsia paysonii* (Rollins) Al-Shehbaz.

Herbs, annual or biennial; trichomes simple or absent; stems simple, or few-branched at base or above. Basal leaves petiolate, rosulate or not, entire or dentate to runcinate or pinnatifid; cauline leaves petiolate or uppermost sometimes subsessile, often not auriculate, entire or dentate to pinnatifid. Racemes corymbose, many-flowered, ebracteate, initially congested but later elongated considerably in fruit; fruiting pedicels slender, ascending to divaricate or horizontal. Sepals oblong to ovate, erect to ascending, caducous, glabrous or pubescent, base of lateral pair slightly saccate or not; petals white or purplish, longer than sepals; petal blade obovate to spatulate, pinnatifid, deeply 2-lobed, repand, or entire; petal claws gradually narrowed from blade to base, glabrous or papillate at base; stamens 6, tetradynamous; filaments glabrous or papillate at base; anthers oblong; lateral nectar glands annular; median glands confluent with laterals; ovules (10 to)20 to 110 per ovary. Fruits dehiscent siliques, linear or rarely linear-oblong, terete or latiseptate, sessile or on gynophore rarely to 3 mm, unsegmented; replum rounded; septum complete, not veined; style distinct; stigma capitate, entire or rarely slightly 2-lobed; seeds uniseriate, ovate to oblong, plump, wingless or rarely narrowly winged; seed coat not mucilaginous when wetted; cotyledons accumbent or incumbent.

KEY TO THE SPECIES OF *DRYOPETALON*

1a. Cauline leaves sessile, auriculate to amplexicaul; fruit 2–3 mm wide; seeds 10 to 28 per fruit, winged . . . *D. viereckii*
1b. Cauline leaves petiolate, not auriculate; fruit 0.5–1.5(–2) mm wide; seeds 30 to 110 per fruit, wingless.
2a. Plants with flowers.
3a. Petal margin pinnatifid, laciniate, or distinctly dentate.
4a. Bases of petal claws and filaments glabrous; flowers purple. . . . . *D. palmeri*
4b. Bases of petal claws and filaments pubescent or distinctly papillate; flowers white.
5a. Leaves entire or shallowly dentate to crenate; petals 4.5–6 mm long . . . . . *D. crenatum*
5b. Leaves pinnatifid to runcinate; petals 6–12 mm long . . . . . *D. runcinatum*
3b. Petal margin entire or repand, rarely with a few obscure teeth.
6a. Bases of petal claws and filaments pubescent . . . . . *D. paysonii*
6b. Bases of petal claws and filaments glabrous.
7a. Petal apex deeply emarginate; cauline leaves entire or dentate . . . . . *D. membranifolium*
7b. Petals apex obtuse; at least some cauline leaves pinnately lobed.
8a. Petals 5–6.5 × 2–2.5 mm, white; ovaries and young fruits stipitate. . . . . *D. breedlovei*
8b. Petals 7–10 × 4–5.5 mm, lavender; ovaries and young fruits sessile . . . . . *D. byei*
2b. Plants with mature fruits.
9a. Cauline leaves entire, rarely shallowly dentate or crenate.
10a. Fruits 1.1–1.5 mm wide; fruiting pedicels 5–11(–13) mm long; style 1.5–2.5 mm long; petals if present dentate, obtuse at apex . . . . . *D. crenatum*
10b. Fruits 0.7–0.9 mm wide; fruiting pedicels 14–20 mm long; style to 1 mm long; petals if present entire, emarginate at apex. . . . . *D. membranifolium*
9b. At least some cauline leaves pinnately lobed.
11a. Fruits sessile or rarely subsessile and with a gynophore 0.1–0.4 mm long.

12a. Style 1.5–2.5 mm long; cotyledons incumbent; petals if present entire . . . . . *D. byei*
12b. Style 0.1–0.7(–1) mm long; cotyledons accumbent; petals if present pinnatifid. . . . . *D. runcinatum*
11b. Fruits on a distinct gynophore (0.6–)1–3 mm long.
13a. Fruits 0.5–0.8 mm wide; seeds 0.6–0.9 × 0.5–0.6 mm; stigma slightly 2-lobed . . . . . *D. breedlovei*
13b. Fruits 1.3–2 mm wide; seeds 1–1.7 × ca. 1 mm; stigma entire.
14a. Style cylindrical; gynophore 0.6–1 mm long; uppermost leaves coarsely dentate; petals if present purple, dentate to laciniate . . . . . *D. palmeri*
14b. Style often conical; gynophore 1–3 mm long; all leaves pinnatifid; petals if present white, entire . . . . . *D. paysonii*

1. Dryopetalon breedlovei (Rollins) Al-Shehbaz, comb. nov. Basionym: *Thelypodiopsis breedlovei* Rollins, Contr. Gray Herb. 214: 26. 1984. TYPE: Mexico. Sinaloa: Mun. Sinaloa, Sierra Surutato, Cañon de Tarahumares betw. Arroyo Verde & Rancho Tarahumares, steep N-facing slope, 3200 ft., 27 Feb. 1968, *D. E. Breedlove 15,913* (holotype, GH; isotype, CAS).

Distribution. Mexico (Sinaloa).

The holotype of *Thelypodiopsis breedlovei* was initially annotated by Rollins as *Dryopetalon runcinatum* var. *laxiflorum* Rollins, and except for having crisped instead of laterally divided petals, the two taxa are almost indistinguishable in all other aspects except the fruit base. The fruits of *D. breedlovei* have a distinct gynophore, whereas those of *D. runcinatum* (including the varieties) are sessile.

2. Dryopetalon byei (Rollins) Al-Shehbaz, comb. nov. Basionym: *Thelypodiopsis byei* Rollins, Contr. Gray Herb. 212: 86. 1982. TYPE: Mexico. Chihuahua: Mun. Batopilas, Sierra Madre Occidental, along Arroyo Wimivo (Samachique) betw. Wimivo & Río Batopilas, on N side of Barranca de Batopilas, short-tree and thorn forest, 28 Feb. 1973, *R. A. Bye 3433* (holotype, GH).

Distribution. Mexico (western Chihuahua).

This species is strikingly similar to *Dryopetalon breedlovei*, but it has lavender instead of white flowers, longer and broader petals (see couplet 8 in the key above) that are not crisped, purplish instead of yellowish anthers, and longer (4–6 cm) and sessile (vs. shorter [2–3 cm] and stipitate) fruits.

3. Dryopetalon crenatum (Brandegee) Rollins, Contr. Dudley Herb. 3: 202. 1941. Basionym: *Sisymbrium crenatum* Brandegee, Proc. Calif. Acad. Sci. 3: 111. 1891. *Cardamine crenata* (Brandegee) Brandegee, Zoe 5: 156. 1903. TYPE: Mexico. Lower [Baja] California: Sierra de la Laguna, 2 Jan. 1890, *T. S. Brandegee 6* (holotype, UC; isotype, GH).

Iodanthus striatus M. E. Jones, Contr. W. Bot. 15: 126. 1929. TYPE: Mexico. Baja California: Todos Santos, 17 Feb. 1928, *M. E. Jones 24189* (holotype, POM).

Dryopetalon crenatum var. *racemosum* Rollins, Contr. Dudley Herb. 3: 203. 1941. Syn. nov. TYPE: Mexico. Lower [Baja] California: Esperitor Santo Island, beach, 1 Apr. 1931, *G. N. Collins, T. H. Kearney & J. H. Kempton 125* (holotype, GH).

Distribution. Mexico (Baja California Sur).

As in *Dryopetalon runcinatum* (see below), plants of *D. crenatum* exhibit considerable variation in the density of flowers along the racemes. The type of *D. crenatum* has laxly flowered racemes, whereas the type of variety *racemosum* has somewhat densely flowered racemes. In my opinion, these slight differences do not justify the division of the species into varieties.

4. Dryopetalon membranifolium Rollins, Contr. Gray Herb. 214: 21. 1984. TYPE: Mexico. Sinaloa: 51 km by rd. from Villa Union on rd. to Durango, 800 m, steep slopes with shrubby woods, just below oak zone, 11–12 Mar. 1970, *W. R. Anderson & C. Anderson 6172* (holotype, GH).

Distribution. Mexico (Sinaloa).

This distinctive species is easily distinguished from the remainder of the genus by having emarginate petals without lateral lobes.

5. Dryopetalon palmeri (S. Watson) O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 10: 561. 1929. Basionym: *Cardamine palmeri* S. Watson, Proc. Amer. Acad. Arts 24: 38. 1889. *Sibara palmeri* (S. Watson) Greene, Pittonia 3: 12. 1896. TYPE: Mexico. Lower [Baja] California: Muleje, Gulf of California, near Saltwater, foothills, 25 Dec. 1887, *E. Palmer 421* (holotype, GH).

Dryopetalon purpureum Rollins, Contr. Dudley Herb. 3: 204. 1941. Syn. nov. TYPE: Mexico. Lower [Baja] California: Magdalena Island, Mar. 1917, *C. R. Orcutt 17* (holotype, GH).

Distribution. Mexico (Baja California Sur, western Sonora; Rollins, 1941).

The main differences given by Rollins (1941, 1993) to distinguish *Dryopetalon palmeri* from *D. purpureum* are the presence in the former of spatulate petals with a bifid to deeply divided terminal lobe (vs. broadly spatulate to obovate petals with an entire terminal

lobe) and lowermost fruiting pedicels ca. 1 (vs. 1.5–2) cm long. The lowermost pedicels in the type of *D. purpureum* are 1–1.5 cm long, in the type of *D. palmeri* are 0.9–1.3 cm, and in 11 additional collections annotated by Rollins as *D. palmeri* are 0.8–2 cm long. Furthermore, the degree of lobing along the petal margin is highly variable in the species, and the terminal lobe is often undivided and rarely bifid or deeply divided. As for petal shape and length of the claw, there is a continuous variation in both aspects and this variation does not correlate with the lobing of petals or with the length of fruiting pedicels. Therefore, I conclude that these two taxa are conspecific.

6. Dryopetalon paysonii (Rollins) Al-Shehbaz, comb. nov. Basionym: *Thelypodium paysonii* Rollins, Rhodora 59: 61. 1957. *Rollinsia paysonii* (Rollins) Al-Shehbaz, Taxon 31: 422. 1982. TYPE: Mexico. Coahuila: Cañon de Jara, E of Socorro, lower part of canyon near its mouth, ca. 30 km W of Cuatro Cienegas, 1–15 Feb. 1941, *Albert H. Schroeder 12* (holotype, GH).

Distribution. Mexico (Coahuila, Durango; Al-Shehbaz, 1973).

7. Dryopetalon runcinatum A. Gray, Smithsonian Contr. Knowl. 5: 11. 1853. TYPE: Mexico. Chihuahua: s. loc., 1852, *C. Wright 1314* (holotype, GH; isotype, MO).

Sisymbrium umbrosum B. L. Robinson, Bot. Gaz. 30: 60. 1900. *Coelophragmus umbrosus* (B. L. Robinson) O. E. Schulz, Pflanzenr. IV. 105(Heft 86): 158. 1924. TYPE: Mexico. Chihuahua: Puerta de St. Diego, shady places in rocks, 6500 ft., 12 Apr. 1891, *C. V. Hartman 629* (holotype, GH).

Dryopetalon runcinatum var. *laxiflorum* Rollins, Contr. Dudley Herb. 3: 201. 1941. Syn. nov. TYPE: Mexico. Sinaloa: San Blas, 30 Jan. 1927, *M. E. Jones 22842* (holotype, GH).

Distribution. Mexico (Chihuahua, Sinaloa, Sonora), United States (Arizona, New Mexico); see Rollins (1941).

Dryopetalon runcinatum is highly variable in the density of indumentum on the leaves and along the lower portions of the stem. In plants densely hirsute at the base, the sepals can be either glabrous (e.g., *Ward 81-075*, GH) or pubescent (e.g., *Gentry 1992*, GH), and in other collections there are but one or a few hairs on each sepal. This feature of indumentum does not correlate with the degree of lobing of petals or with the density of fruits in the infructescence. The species occupies diverse habitats ranging from open and sunny slopes or roadsides to shaded areas in canyons and under protection of large boulders. When growing in the shade (e.g., *Gentry 5379*, GH), the plants have rather sparse indumentum near the base, are glabrous distally, and the fruiting racemes are rather lax versus somewhat densely flowered as in plants of sunny areas. Such plants are typical of what has been called variety *laxiflorum*, a taxon, in my opinion, that does not merit recognition.

8. Dryopetalon viereckii (O. E. Schulz) Al-Shehbaz, comb. nov. Basionym: *Arabis viereckii* O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 11: 389. 1932. *Sibara veireckii* (O. E. Schulz) Rollins, Rhodora 43: 481. 1941. TYPE: Mexico. Nuevo León: Victoria, 27 Feb. 1930, *H. W. Vireck 54* (holotype, B).

Arabis endlichii O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 11: 390. 1932. *Sibara viereckii* var. *endlichii* (O. E. Schulz) Rollins, Rhodora 43: 479. 1941. TYPE: Mexico. Coahuila: Rancho de la Luz, Sierra & Hacienda de la Paila, 900 m, 1 Apr. 1905, *R. Endlich 814* (lectotype, designated here, B).

Arabis runcinata S. Watson, Proc. Amer. Acad. Arts 17: 319. 1882, non *Arabis runcinata* Lamarck, Encycl. 1: 222. 1783. *Sibara runcinata* Rollins, Rhodora 43: 481. 1941. TYPE: Mexico. Near San Luis Potosí, shaded places, *J. G. Schaffner 155* (holotype, GH).

Sibara runcinata var. *brachycarpa* Rollins, Contr. Gray Herb. 165: 138. 1947. TYPE. United States. Texas: La Salle Co., Cotulla, Mar. 1917, *E. J. Palmer 11314* (holotype, RM).

Distribution. Mexico (Coahuila, Hidalgo, Nuevo León, Puebla, San Luis Potosí, Zacatecas), United States (southern Texas); see Rollins (1947).

Schulz (1932) cited two collections in his original description of *Arabis endlichii*. The more complete specimen with flowers and fruits is designated herein as the lectotype.

The species is highly variable in the division of cauline leaves, the size and development of leaf auricles, size of fruits (1.5–4.7 cm), length of fruiting pedicels (3–14 mm), and length of style (0.4–4 mm). Rollins (1947) divided it into two species and two varieties but later (1993) accepted a highly polymorphic species without infraspecific taxa. The species is somewhat anomalous in *Dryopetalon* for having latiseptate fruits to 3 mm wide (vs. terete or latiseptate but to 2 mm wide), auriculate (vs. non-auriculate) cauline leaves, and narrowly winged (vs. wingless) seeds. However, these differences are exhibited within many other genera of the family, and they are considered to be insignificant in the delimitation of this genus.

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Six New Species of *Phacelia* (Hydrophyllaceae) from Arizona and New Mexico

N. Duane Atwood
Assistant Curator, Stanley L. Welsh Herbarium, Brigham Young University, Provo, Utah 84602-0200, U.S.A. duane_atwood@byu.edu

ABSTRACT. Six new species of *Phacelia* Jussieu are described from Arizona and New Mexico, U.S.A., as *P. buell-vivariensis* N. D. Atwood, *P. cloudcroftensis* N. D. Atwood, *P. furnissii* N. D. Atwood, *P. higginsii* N. D. Atwood, *P. hughesii* N. D. Atwood, and *P. pinkavae* N. D. Atwood. The new species all belong to the Crenulatae group within the genus. The new species are compared to other members of the group based on similarities and differences in stature, seed, pubescence, and leaf and flower morphology.

Key words: Arizona, conservation status, Hydrophyllaceae, New Mexico, North America, *Phacelia*.

This paper describes six new species of *Phacelia* Jussieu. The new taxa are part of voucher collections made as part of general floristic studies in Arizona, New Mexico, and Utah, and continued fieldwork on the genus in North America. They all belong to the Crenulatae group of the genus, first treated by John W. Voss in his 1937 monograph. This group is characterized by being resinous-glandular (mostly), and having 1 to 4 seeds that are somewhat cymbiform, pitted over most or all of the surface, and excavated on the ventral surface on either side of a central, longitudinal ridge. The most recent treatment of this group was by Atwood (1975). Specimens of the new taxa were compared to collections and descriptions of the 30 North American species in the Crenulatae group, including new taxa described since 1975, and the large collection of the genus at Brigham Young University (BRY).

Specimens of *Phacelia pinkavae* N. D. Atwood, and the name, have been in manuscript form since the early 1990s. I first collected the species in 1974 in early flower and noted the distinctive dark, glandular, mephitic pubescence, but did not recognize the uniqueness of it until additional specimens were made in 1993 and 1994. The excellent 1993 collections of the species by Jon Rebman helped to solidify the observation that the collections do indeed represent a new species. Three of the new taxa of *Phacelia* are from the Arizona Strip north of the Grand Canyon, where extensive fieldwork has been conducted by me and others over the past decade or so. *Phacelia cloudcroftensis* N. D. Atwood and *P. buell-vivariensis* N. D. Atwood are more recent discoveries from farther south in Arizona and New Mexico.

In an earlier publication, in which I described *Phacelia sivinskii* N. D. Atwood, P. J. Knight & Lowry (Atwood, 2005), I inadvertently failed to acknowledge for whom the species was being named. It was named in honor of Robert Sivinski, State Botanist for the Forestry Division of the New Mexico Department of Energy, Minerals, and Natural Resources Management. Bob has made, and continues to make, significant contributions to the knowledge of the flora of New Mexico. Bob has graciously provided help on several of my botanical trips to New Mexico, which I greatly appreciate.

KEY TO RELATED SPECIES IN *PHACELIA*

1a. Stamens and style included; corolla lobes denticulate . . . . . *P. denticulata* Osterhout
1b. Stamens and style exserted 1 mm or more; corolla lobes entire, crenulate or erose-denticulate 2
2a. Stamens and style exserted 1–1.7 mm; mature seeds 3 per capsule, brown, 3.6–3.9(4.3) × (1.2)1.6–1.7 mm; robust annuals, stems to 2 cm thick; cauline leaves rarely divided to the midrib; plants from the Sacramento Mountains, Otero Co., New Mexico . . . . . *P. cloudcroftensis* N. D. Atwood
2b. Stamens and style exserted 2 mm or more; mature seeds 4 per capsule; stems to 1 cm thick and not with the above combination of characters 3
3a. Cauline and basal leaves strongly dissected, sub-bipinnatifid; corolla 3–4(5) mm long, white to lavender, broadly tubular-campanulate; lobes broadly rounded, erose-fimbriate or erose-dentate; seeds (2)4 × 2.4–3.2 mm, uniformly brown . . . . . *P. alba* Rydberg
3b. Leaves not sub-bipinnatifid and strongly dissected, if dissected then not strongly so and restricted to the basal or lower cauline leaves. 4
4a. Corolla campanulate, 5.8–6.5 mm long, blue or violet; restricted to Lincoln and Clark counties (southern Nevada), northwestern Mohave Co. (Arizona), and Washington Co. (Utah) (disjunct in San Juan Co., Utah). 5
4b. Corolla tubular, tubular-campanulate, white (pale lavender) or violet, mostly less than 6 mm long or if over 6 mm long then the corolla lavender to bluish 6
5a. Corolla 5.8–6 mm long, blue with a lighter tube; sepals elliptic to narrowly oblanceolate, 3–3.4(4.2)

× 0.9–1.5 mm, not enlarging in fruit; seeds excavated on each side of the ventral ridge, the ridge corrugated on one side and on the inside margins; plants of Lincoln and Clark counties (southern Nevada), northwestern Mohave Co. (Arizona), and Washington Co. (Utah) (disjunct in San Juan Co., Utah) . . . . . *P. petrosa* N. D. Atwood, F. J. Smith & T. A. Knight

5b. Corolla 6–6.5 mm, violet with darker maroon veins on the tube and lobes; sepals narrowly obovate to spatulate, 2.5–2.8 × 0.5–0.8 mm wide, to 5–6 mm long in fruit; seeds flattened ventrally and essentially lacking excavations and corrugations; plants known only from northwestern Mohave Co., Arizona . . . . . *P. furnissii* N. D. Atwood

6a. Corolla tubular-campanulate, lavender, 5–6.5 mm long and broad; mature seeds oblong-elliptic, 3.1–4.5 × 1.7–2.2 mm, lacking corrugations on the margins and ridge, transversely ridged dorsally, the ventral ridge prominent and curved to one side; restricted to deep sandy soils; widely distributed species from southeastern Utah to Texas and Mexico . . . . . *P. integrifolia* Torrey ex S. Watson

6b. Corolla tubular or tubular-campanulate, 6 mm long or less, white, violet, lavender, or bluish and not with the above combination of characters; plants of volcanic, limestone, or clay soils; more restricted in distribution in Arizona and New Mexico. 7

7a. Mature seeds dark brown; corolla light violet or bluish, 3–5 × 2–3 mm; pubescence of stems and leaves densely covered with light reddish, yellowish, or black stipitate glands; plants restricted to volcanic pumice on the volcanic cones north of Flagstaff, Coconino Co., Arizona, or Buell Park, Apache Co., Arizona 8

7b. Mature seeds black; corolla white or pale violet or pale lavender, 4.2–6.5 mm long; plants mostly more northern in distribution except *P. pinkavae* from eastern Apache Co., Arizona, and Catron, Sandoval, and Santa Fe counties, New Mexico 9

8a. Stems reddish, densely retrorsely puberulent and with yellowish sessile and stipitate glands; lacking setose to hirsute hairs; sepals 2.2–2.5 × 1–1.1 mm; seeds 2.5–2.6 × 1 mm, oblong to narrowly lanceolate, lacking corrugations except a few faint waves on the ventral ridge, the margins not involute . . . . . *P. buell-vivariensis* N. D. Atwood

8b. Stems light green to black, with retrorsely puberulent, black to dark red sessile and stipitate glands, and longer setose to hirsute hairs; sepals 3–4 × 0.7–1.5 mm; seeds 2.5–3.4 × 2–2.5 mm, elliptic-oblong, corrugated on the involute margins and one side of the ridge . . . . . *P. serrata* J. W. Voss

9a. Plants densely covered with short and long black multicellular capitate glands and short nonglandular hairs; fruiting sepals ca. twice as long as the capsule; plants of northeastern Arizona and northwestern New Mexico . . . . . *P. pinkavae* N. D. Atwood

9b. Plants lacking black stipitate glands; sepals shorter to a little longer than the capsule; plants of western Colorado, northern Arizona, south-central and southern Utah, and Clark Co., Nevada. .10

10a. Robust, malodorous plants (2)5.3–9.8 dm tall, densely glandular with stipitate glands; leaves relatively broad, the lower the largest, to 10(13) × 4 cm; the cauline 2–4 × longer than broad 11

10b. Plants less robust, sweetly odorous, 1.5–4.3 dm tall, not as strongly glandular, densely retrorsely pubescent to hirsutulous and hirsute; leaves more narrow, linear to linear-lanceolate or more broadly oblong, 1–10 × 0.3–1.5 cm, often revolute 12

11a. Plants strongly malodorous, densely glandular throughout with sessile to stipitate glands; sepals 3–4 × 1–1.8 mm; stems leafy but not densely so; seeds elliptic, 2.5 × 1.5 mm; plants from southwestern Utah, northwestern Arizona, and southeastern Nevada . . . . . .*P. palmeri* Torrey ex S. Watson

11b. Plants less glandular and mephitic, more hirsute; stems densely leafy on the main stem; sepals shorter and narrower, 2.2–3.2 × 0.5–0.6 mm; seeds ovate, 2.1–2.5 × 1.1–1.2 mm; plants below the Shivwits Plateau in Mohave Co., Arizona . . . . . *P. higginsii* N. D. Atwood

12a. Herbage densely covered with sessile to 3-celled stipitate glands and short to longer simple hairs; stamens and style exserted 5–6 mm; leaves lanceolate to oblong, often broadly so, to 2.2 cm wide; plants of Sandoval, Cibola, and Socorro counties, New Mexico . . . . . *P. sivinskii* N. D. Atwood, P. J. Knight & Lowry

12b. Herbage hirsute to hirsutulous, glands sessile or short-stipitate but lacking 3-celled stipitate glands; stamens and style exserted less than 5 mm; leaves more narrowly lanceolate to oblong, less than 1.5 cm wide; plants of Colorado or Utah. 13

13a. Flowers to 4.5 mm long with dark veins on the tube and lobes; seeds 1.9–2 × 1.1–1.3 mm, short-elliptic to oval; leaves various but not strongly revolute and mostly less than 3 cm × 2.2–4.3 mm; cymes in fruit elongating to 10 cm long . . . . . .*P. hughesii* N. D. Atwood

13b. Flowers 5–6 mm long, lacking dark veins; seeds (2)2.5–2.8 × 1–1.2 mm, elliptic; leaves linear-lanceolate, strongly revolute, 1.5–7(10) × 0.08(1.3) cm; cymes in fruit elongating to 5 cm long . . . . . .*P. constancei* N. D. Atwood

1. Phacelia buell-vivariensis N. D. Atwood, sp. nov. TYPE: U.S.A. Arizona: Apache Co., Buell Park on N side of Peridot Ridge, 35°53.79′N, 109°5.06′W, Navajo Indian Reservation, 5 Aug. 2004, *N. D. Atwood & A. Clifford 30555* (holotype, BRY; isotypes, ASC, ASU, BRY, CAS, GH, MO, NY, OSC, RM, US). Figure 1.

Phaceliae serratae J. W. Voss pubescentia caulina pallida vel atrorubrescenti stipitato-glandulari similis, sed caulibus rubris retrorse pubescentibus trichomatibus flavescentibus stipitato-glandularibus (non setosis vel hirsutis) sepalis aliquantum brevioribus et angustioribus, 2.2–2.5 × 1–1.1 mm (non 1.8–3 × 0.8–2 mm) et seminibus minoribus et minus corrugatis, 2.5–2.6 × 1 mm (non 3–3.2 × 1–1.3 mm).

Annual, 2.9–4 dm tall; stems reddish, solitary or with 1 to 4 smaller stems from the base, densely retrosely white puberulent and glandular, the glands light reddish to yellow, sessile to short-stipitate, the stalks flat, 1- to 3-celled. Leaves petiolate, petiole 1–

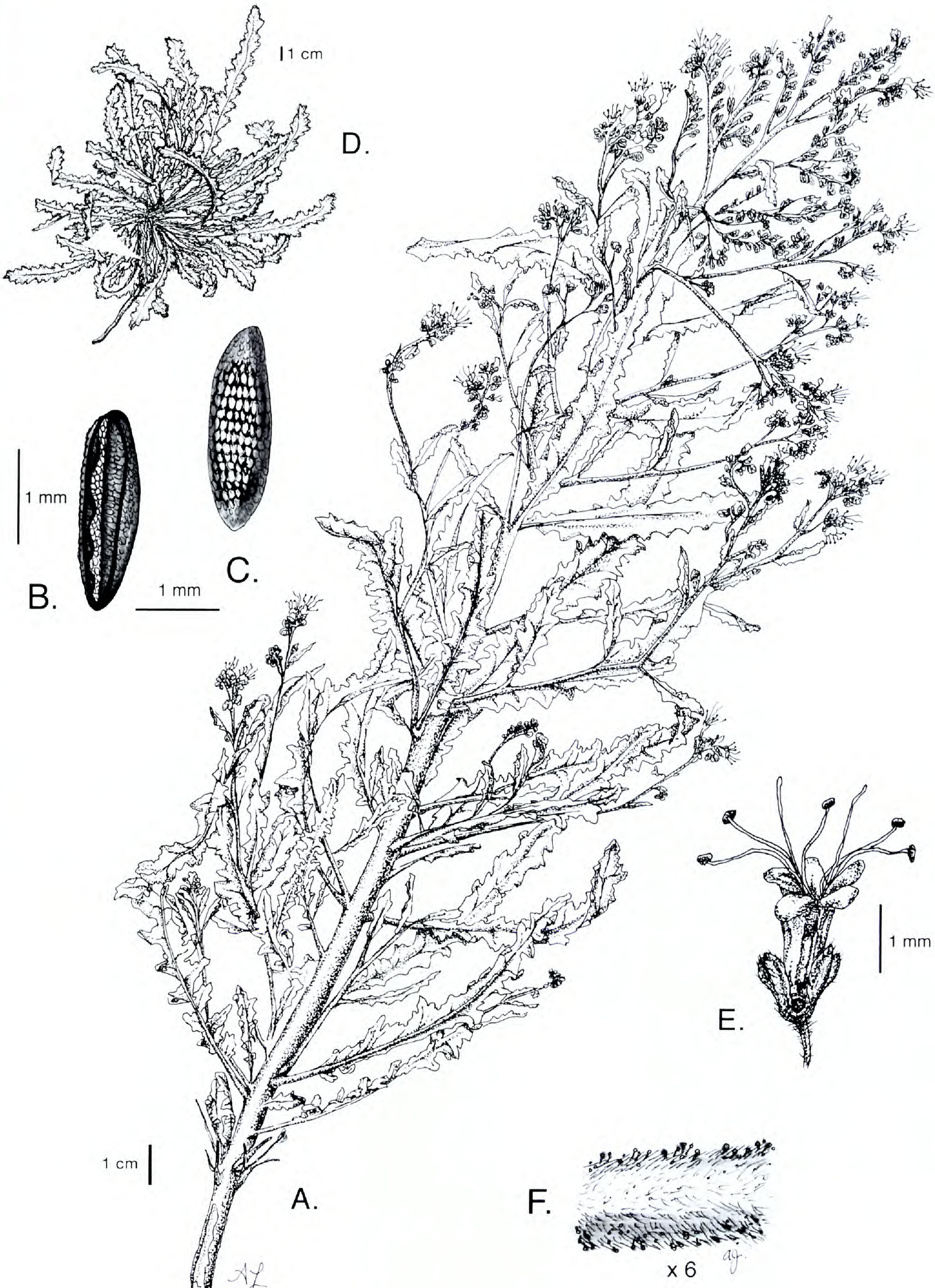

Figure 1. *Phacelia buell-vivariensis* N. D. Atwood. —A. Plant. —B. Ventral surface of seed. —C. Dorsal surface of seed. —D. Rosette. —E. Flower. —F. Stem pubescence. Drawn from the type collection, *N. D. Atwood & A. Clifford 30555* (BRY).

3 mm, the basal ones to 1 cm; blades linear to oblong-lanceolate, pinnatilobate or irregularly lobed, 1–8 × 0.2–1.5 cm, the margins sometimes involute, reduced upward, some basal leaves pinnately compound, dorsal surface scabrous-hispid and stipitate-glandular, ventral surface also densely stipitate-glandular. Inflorescence terminal on the short lateral branches and main stem, puberulent and with coarser,

more densely yellowish stipitate glands than the stem; cymes 1- to 15-flowered, 1.1–3 cm; sepals in flower elliptic 2.2–2.5 × 1–1.1 mm, in fruit 3.5–4 × 1.3–2 mm, densely short stipitate-glandular; corolla tubular to tubular-campanulate, 4 mm, violet or blue, pubescent on the lobes; stamens and style exserted 2–4 mm, anthers bronze, filaments violet. Capsules oblong, 2.8–3.5 × 2 mm, shorter to ± equal to the sepals, finely stipitate-glandular and puberulent; mature seeds 2.5–2.6 × 1 mm, oblong to narrowly lanceolate, brown, excavated on both sides of the ventral ridge, one side of the ventral ridge very lightly corrugated, the margins entire, dorsal surface finely pitted.

Etymology. *Phacelia buell-vivariensis* is named for Buell Park, the type locality.

Relationships. The new species is related to *Phacelia serrata* but differs in having red stems with retrorse puberulent hairs and short yellowish stipitate glandular hairs but without setose to hirsute hairs; *P. buell-vivariensis* resembles *P. serrata* in having light to reddish black stipitate glandular pubescence on the stems. *Phacelia buell-vivariensis* also has somewhat different sepals (2.2–2.5 × 1–1.1 mm vs. 1.8–3 × 0.8–2 mm) and smaller, nearly noncorrugated seeds (2.5–2.6 × 1 mm vs. 3–3.2 × 1–1.3 mm). One side of the ridge is somewhat wavy with no distinct corrugations on the margins and ridge as in *P. serrata*.

Distribution and habitat. It is known only from the type locality in Buell Park, Apache Co., Arizona, on volcanic pumice in a *Juniperus monosperma* (Engelmann) Sargent, *Pinus ponderosa* Douglas ex C. Lawson & G. Lawson, *Bouteloua gracilis* (Kunth) Lagasca ex Griffiths, and *Artemisia campestris* L. community at 7191 ft. elevation.

Conservation status. The Nature Conservancy global and state rarity ranking for this species should be G1S1, based on the single known occurrence.

2. Phacelia cloudcroftensis N. D. Atwood, sp. nov. TYPE: U.S.A. New Mexico: Otero Co., Sacramento Mtns., rd. cut 3.5 mi. W of Cloudcroft on Hwy. 82 W of Jct. 82/130, 32°57.59′N, 105°46.47′W, 22 July 2003, *N. D. Atwood & B. Furniss 29680* (holotype, BRY; isotypes, ASU, BRY, CAS, GH, MO, NMC, NY, RM, SJNM, UNM). Figure 2.

Phaceliae denticulatae Osterhout habitu similis, sed caulibus robustioribus elatioribus, cymis virgatis sub fructescentia longioribus, staminibus et stylis exsertis, sepalis longioribus et latioribus, 1.5–2.5 mm latis (non 0.8–0.9 mm latis) et seminibus majoribus et latioribus, uniformiter lacunosis, crista ventrali magis corrugatis differt.

Plants to 4.7 dm tall; stems densely covered with short retrorse appressed to spreading simple hirsute hairs, short to long, dark red to black, 1- to several-celled capitate-glandular hairs. Cauline leaves broadly lanceolate, 3.8–10 × 1.4–4.6(5.5) cm, irregularly crenate-dentate or lobed, densely pubescent with dark stipitate to sessile glands and hirsute hairs especially on the veins and leaf margins, the lower and basal leaves deeply lobed to pinnatifid. Inflorescence in terminal cymes on the main stem and lateral branches, densely glandular and hirsute, cymes 2 or 3 on lateral branches, more crowded and dense on the upper main stem, cymes elongating to 8.5–15 cm in fruit; corolla tubular, ca. 4–4.5 mm, lobes crenate to erose-denticulate, 1 mm; stamens and style exserted 1–1.7 mm, style bifid 3/4 its length, hispidulous from the base to above the forks; calyx divided to within 1 mm of the base, lobes densely glandular and hirsute, unequal, linear to oblanceolate, 2.5–3.5 mm in flower, to 5 mm in fruit, 1.5–2.5 mm wide in fruit, longer than the capsule, the midnerve keeled. Capsule oblong, 4.5–5 mm, densely short-glandular and setulose; seeds 3, dark brown, 3.6–3.9(4.3) × (1.2)1.6–1.7 mm, shallowly excavated from the up-turned margins, uniformly pitted, ridge usually corrugated on one side.

Etymology. *Phacelia cloudcroftensis* is named for the town of Cloudcroft in the Sacramento Mountains.

Relationships. *Phacelia cloudcroftensis* is most closely related to *P. denticulata* in general habit, seed characters, and the somewhat virgate thinner (to 1 cm thick), usually weaker stems. However, *P. cloudcroftensis* is much more robust with stronger stems to 2 cm thick, longer fruiting cymes to 15 cm in fruit (vs. to 10 cm), the ventral ridge of the seeds more corrugated, and broader fruiting sepals (1.5–2.5 mm wide vs. 0.8–0.9 mm wide). The new species has exserted stamens and style versus the included stamens and style of *P. denticulata*. The new species also has some relationship to *P. alba* in having exserted stamens and style and erose to erose-denticulate corolla lobes versus denticulate corolla lobes, but differs in having larger seeds (3.6–4.3 × 1.2–1.7 mm vs. 4 × 1.7 mm) and more virgate and thicker stems to 2 cm thick (vs. stems ≤ 1 cm thick). It differs from both of these species in the very broad, irregularly crenate to dentate, broadly lanceolate simple cauline leaves versus smaller, more delicate, pinnately to bipinnately divided mid to upper cauline leaves.

Distribution, habitat, and phenology. The first and only collection known of *Phacelia cloudcroftensis*, with the exception of the type material, was made by Helen

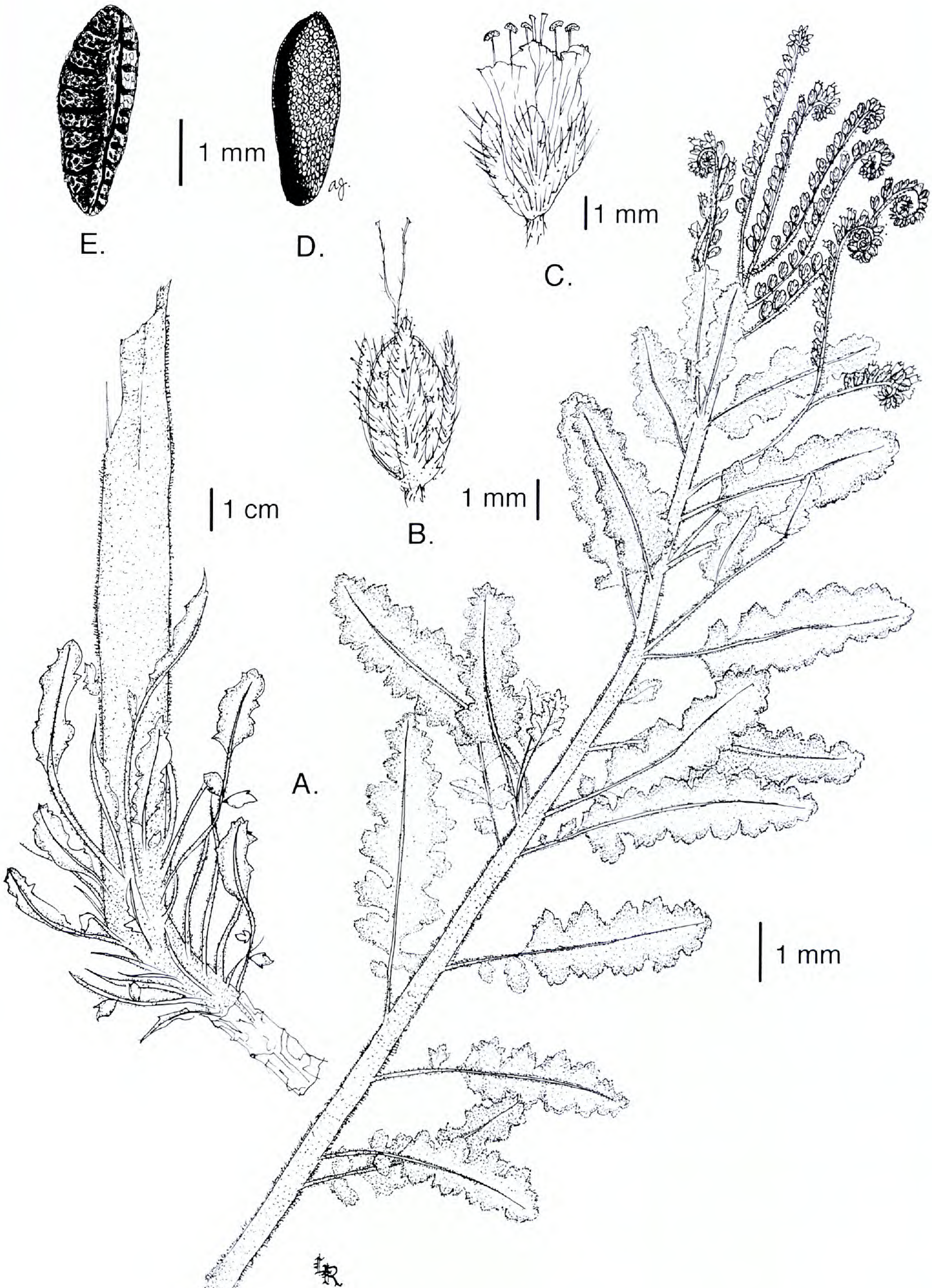

Figure 2. *Phacelia cloudcroftensis* N. D. Atwood. —A. Plant. —B. Fruit. —C. Flower. —D. Dorsal surface of seed. —E. Ventral surface of seed. Drawn from the type collection, *N. D. Atwood & B. Furniss 29680* (BRY).

Bobisud in the 1960s. The Bobisud collection was part of material borrowed from herbaria in the southwestern United States to gain a better understanding of *P. integrifolia* and related taxa. The specimen had been identified as *P. integrifolia*, a name that has been loosely used incorrectly for numerous collections. The new species is presently known only from 3 to 3.5 miles west of Cloudcroft,

New Mexico, along U.S. Hwy. 81. Flowering July–late September, or probably even into October.

Conservation status. The Nature Conservancy global and state rarity ranking for this species should be G1S1, based on the two small populations of only a few individual plants.

Paratypes. U.S.A. **New Mexico:** Otero Co., 3 mi. W of Cloudcroft on U.S. 82, 31 July 196?, *Helen Bubisud 132* (BRY [xerograph], UNM); 3.8 mi. W of Cloudcroft on Hwy. 82, T15S, R13E, S1, 7 Sep. 2002, *N. D. Atwood 29003* (BRY, K, NMC, RSA, UNM).

3. Phacelia furnissii N. D. Atwood, sp. nov. TYPE: U.S.A. Arizona: Mohave Co., Arizona Strip, Grand Canyon–Parashant National Monument, Andrus Canyon at rd. crossing, T32N, R10W, S6 & 7, 27 May 2003, *N. D. Atwood & L. C. Higgins 29469* (holotype, BRY; isotypes, ARIZ, ASU, BRY [5], K, MO, NY, OSC, RM, TEX, UNLV, UNM, US). Figure 3.

Phaceliae petrosae N. D. Atwood, F. J. Smith & T. A. Knight affinis, sed caulibus saepe magis virgatis, robustioribus et elatioribus, floribus majoribus pallide violaceis, in tubo et lobis venis atropurpureis, capsulis minoribus et seminibus et foliis differt.

Tall robust annual or possible winter annual, producing basal leaf rosettes in the late summer or fall after the first rains; stems solitary or few branches from the base, more often with numerous lateral branches to 2.8 dm, leafy flowering branches to just below the terminal part of the main stem inflorescence, 3.2–8 dm tall, densely glandular with short to long 1-celled or multicellular reddish to black stipitate glands. Basal rosette of leaves deeply sinuate to pinnatifid, oblong, persisting into the fruiting stage, densely covered with stipitate-glandular hairs as on the stem, ventral surface also with pustulate setose to hispid pubescence, less so on the dorsal surface, 4–11 × 1.5–2.5 cm, petiolate, petiole to 4 cm; cauline leaves to ca. the middle of the stem and mostly lacking in the inflorescence, crenate to irregularly lobed mostly less than 1/2 the way to midrib, broadly lanceolate, densely stipitate-glandular. Inflorescence densely flowered, of lateral and terminal cymes, cymes terminating lateral branches solitary or in pairs, the terminal cyme group of the main stem 8–20 cm long, each cyme mostly single and alternate, not paired, individual cymes 1–4 cm in flower, elongating to 8 cm in fruit, densely stipitate-glandular; flowers campanulate, 6–6.5 mm, pale violet with darker maroon veins on the tube and lobes, pedicellate, pedicel 0.5 mm in flower, lobes ca. 2 mm broad and often puberulent and glandular-stipitate; calyx lobes narrowly obovate to spatulate, 2.5–2.8 × 0.5–0.8 mm, with black stipitate-glandular and hirsute hairs in flower, 5–6 mm in fruit, the midrib raised; fruiting pedicels ca. 1 mm; stamens and style exserted 4–5.5 mm, style forked to ca. the middle and pubescent to the forks, filaments violet, anthers bronze. Capsules 3.4–3.5 × 2.5 mm, oblong, glandular dotted and appressed setulose; seeds brown, oblong, flattish ventrally on each side of the prominent ridge and essentially lacking the typical excavations on either side of the ridge, coarsely pitted on each side of the ridge, pitting on the ridge smaller, dorsal surface slightly rounded, pitted, faintly cross-corrugated, 3–3.4 × 1.2–1.4 mm.

Etymology. *Phacelia furnissii* is named for Blaine Furniss of Brigham Young University, who has provided valuable assistance on numerous field trips, including collection of several of the paratypes.

Relationships. *Phacelia furnissii* is allied to *P. petrosa* but differs from that species in the often more virgate, robust, and taller stems (3.2–8 dm vs. 1–3.6 dm), larger pale violet flowers with dark maroon veins on tube and lobes (vs. blue corolla with a lighter tube and base), smaller capsules (3.4–3.5 × 2.5 mm vs. 4–4.3 × 3–3.3 mm) and different seed (oblong flattish, corrugated and pitted ventrally from the edge to the ridge on each side, the ridge low and essentially lacking the typical excavations on either side, dorsal surface slightly rounded, faintly cross-corrugated, 3–3.4 × 1.2–1.4 mm vs. seeds deeply excavated with longer and narrower pitting, corrugations only on one side of the prominent ridge and margins, 3.3–3.8 × 1.5–3.1 mm), and leaf morphology.

Distribution, habitat, and phenology. At the type locality in Andrus Canyon, *Phacelia furnissii* occupies habitat in association with six other species of *Phacelia*—*P. petrosa*, *P. pedicellata* A. Gray, *P. ambigua* M. E. Jones, *P. glechomaefolia* A. Gray, *P. coerulea* Greene, and *P. rotundifolia* Torrey ex S. Watson. Each species is easily distinguished from each other with no apparent hybrids. Of the species present, it appears to be most closely related to *P. petrosa*. At the other known sites, it is the primary species in the habitat where it has been collected (i.e., Hack, Whitmore, and Parashant canyons of northwestern Mohave County, Arizona. It flowers in April and May, and apparently has a longer period for development of mature seeds, into September or early October. It is easily distinguished, especially in flower, by its large, 5–6 mm long, pale lavender flowers with the dark maroon veins on the tube and limbs. The terminal group of cymes are 8–20 cm long.

It occurs in limestone gravels and boulders of wash bottoms and steep limestone talus of desert

Figure 3. *Phacelia furnissii* N. D. Atwood. —A. Plant. —B. Fruit. —C. Flower. —D. Ventral surface of seed. —E. Dorsal surface of seed. —F. Stem pubescence. Drawn from the type collection, *N. D. Atwood & L. C. Higgins 29469* (BRY).

shrub communities with *Fraxinus anomala* Torrey ex S. Watson, *F. cuspidata* Torrey var. *macropetala* (Eastwood) Rehder, *Berberis fremontii* Torrey, *Ptelea trifoliata* L., *Bernardia incana* C. V. Morton, *Rhus trilobata* Nuttall, *Fallugia paradoxa* (D. Don) Endlicher ex Torrey, *Atriplex canescens* (Pursh) Nuttall, *Gutierrezia microcephala* (DC.) A. Gray, scattered *Juniperus monosperma*, *Pinus edulis* Engelmann in

Wislizenus, and *Stipa speciosa* Trinius & Ruprecht at 3681–4600 ft. (1100–1400 m) elevation.

Conservation status. The Nature Conservancy global and state rarity ranking for this species should be G1S2, based on the limited distribution.

Paratypes. U.S.A. **Arizona:** Mohave Co., Arizona Strip, Grand Canyon–Parashant National Monument (GCPNM), T33N, R12W, S17 W of Andrus Canyon, 19 Apr. 2000, *N. D. Atwood, L. C. Higgins & B. Furniss 25062* (BRY); GCPNM, T33N, R12W, S26, 19 Apr. 2000, *N. D. Atwood, L. C. Higgins & B. Furniss 25078* (BRY); GCPNM, 4 mi. down Andrus Canyon, T33N, R12W, S26, 19 Apr. 2000, *N. D. Atwood, L. C. Higgins & B. Furniss 25084* (BRY); GCPNM, Trail Canyon at rd. T32N, R10W, S6 & 7 at rd. crossing, 19 Apr. 2000, *N. D. Atwood, L. C. Higgins & B. Furniss* 25097 (BRY); GCPNM, Andrus Canyon, T33N, R12W, S26, 19 Apr. 2000, *N. D. Atwood, L. C. Higgins & B. Furniss 25084* (BRY); GCPNM, Andrus Canyon above rd. crossing, 11 Oct. 2000, *N. D. Atwood 26249* (BRY); GCPNM, ca. 7 mi. down Parashant Canyon from Trail Canyon summit, 11 Oct. 2000, *N. D. Atwood 26279* (BRY); GCPNM, Andrus Canyon, T32N, R10W, S7NWNW, 17 Apr. 2003, *N. D. Atwood & L. C. Higgins 29158* (BRY [2], CPH, DAV, FSU, GH, MU, NLU, RSA, SRP, UNLV); GCPNM, Andrus Canyon, T32N, R10W, S18NE1/4, 17 Apr. 2003, *L. C. Higgins & N. D. Atwood 24366* (BRY, Dixie State College, UNLV); GCPNM, Andrus Canyon, 1–4 mi. above rd. crossing, T32N, R11W, S1, 24, 25 & 36, 27 May 2003, *N. D. Atwood 29478* (ARIZ, ASU, BM, BRY, K, MO, NMU, NY, OSC, RM, TEX, UNM, US); bottom of Trail Canyon, T33N, R10W, S11NE1/4, 27 May 2003, *N. D. Atwood & L. C. Higgins 29495* (ARIZ, ASC, ASU, BM, BRY [2], K, NY, MO, OSC, RM, RSA, SISC, TAES, TEX, UNM, US, WIS); GCPNM, Andrus Canyon, T32N, R10W, S17, 27 May 2003, *L. C. Higgins & N. D. Atwood 24593* (BRY, Dixie State College); GCPNM, Whitmore Wash, 36°12.23′N, 113°18.25′W, 3 Sep. 2003, *N. D. Atwood, B. Furniss & L. C. Higgins 29727* (BRY); GCPNM, in small side draw in Parashant drainage, 36°12.23′N, 113°18.25′W, 18 Sep. 2003, *N. D. Atwood 29892* (BRY); GCPNM, bottom of Trail Canyon, 36°16.72′N, 113°20.00′W, 26 Apr. 2004, *N. D. Atwood 30119* (ARIZ, ASC, ASU, BM, BRY [2], CAS, K, NY, RM, RSA, UNLV); GCPNM, Andrus Canyon, T32N, R10W, 27 Apr. 2004, *N. D. Atwood & L. C. Higgins 30136* (BRY [2], UNLV); GCPNM, Andrus Canyon, T32N, R10W, S21, 27 Apr. 2004, *L. C. Higgins & N. D. Atwood 25325* (BRY, Dixie State College); GCPNM, Parashant Canyon, T33N, R10W, S11, 28 Apr. 2004, *L. C. Higgins & N. D. Atwood 25365* (BRY); GCPNM, bottom of Trail Canyon, T33N, R10W, S2, 28 Apr. 2004, *L. C. Higgins & N. D. Atwood 25382* (BRY, Dixie State College, UNLV); Kanab Plateau BLM administered lands, Hack Canyon 4 mi. down canyon from pond, 36°35.90′N, 112°49.33′W, 11 May 2004, *N. D. Atwood 30188* (BRY [4], CAS, MO, OSC, RSA, TAES, UNLV, WIS); Kanab Plateau BLM administered lands, 2 mi. down Hack Canyon, T37N, R5W, S22, 11 May 2004, *N. D. Atwood 30191* (ARIZ, ASU, BRY [2], NMC, UNLV, UTC); Kanab Plateau BLM administered lands, Hack Canyon, T37N, R5W, S20, 14 May 2004, *L. C. Higgins 25538* (ASC, BRY [2], Dixie State College, TEX).

4. Phacelia higginsii N. D. Atwood, sp. nov. TYPE: U.S.A. Arizona: Mohave Co., Arizona Strip, 12.5 mi. SW from head of Trail Canyon toward Andrus Canyon, 36°11.48′N, 113°19.10′W, 3 Sep. 2003, *N. D. Atwood, B. Furniss & L. C. Higgins 29729* (holotype, BRY; isotypes, ARIZ, ASU, BM, BRY [3], Dixie State College, K, MO, NY, RM, TEX, US). Figure 4.

Phaceliae palmeri Torrey ex S. Watson habitu similis, sed herba minus viscida et mephitica, hirsutiore, interdum perenni (non semper bienni), densius foliata, sepalis brevioribus et angustioribus, 2.2–3.2 × 0.5–0.6 mm (non 4–5 × 1–1.8 mm), corollis tubulari-campanulatis violaceis (non violascentibus vel albis), et seminibus minoribus, 2.1–2.5 × 1.1–1.2 mm (non 2.5 × 1.5 mm) differt.

Perennial or more commonly biennial plants with 1 or sometimes 2 virgate stems (3.5)5.3–9.8 dm tall, leafy with few to numerous short lateral branches to 13 cm long, stem pubescence with a dense mix of spreading short and longer hirsute simple hairs, short-stipitate glands and some longer flattened 2-celled stipitate-glandular ones. Cauline leaves lanceolate to ovate, mostly flat or somewhat revolute on some plants, 1.5–9 × 0.5–2 cm, hirsute and with short spreading capitate glands on both surfaces, regularly to irregularly crenate-dentate, petiolate, petiole 0.5–2 cm; basal rosette prostrate, to 3 dm broad, developing early and withering before flowering, leaves 9–13 × 1.5–3 cm, irregularly crenate to dentate or pinnatifid, dorsal surface densely hirsute, ventral surface with short and longer hirsute pubescence especially on the midrib and veins, petiolate, petiole to 4 cm. Inflorescence of compound cymes densely arranged along the stem on the terminal part of each lateral branch, cymes 1 to 3, 1–5 cm long in flower, to 10 cm in fruit, densely pubescent with a mix of 1- to 4-celled flattened stipitate-glandular hairs and a few long hirsute and small simple hairs; flowers tubular-campanulate, violet, 4.5–5 mm, some of the lobes often pubescent; stamens and style exserted 3.5–5 mm; style bifid 2/3 its length, pubescent to the forks; filaments violet, anthers bronze; calyx lobes narrowly oblanceolate-spatulate or elliptic, shorter than the flowers, densely stipitate-glandular and hirsute especially on the margins, ribs on the dorsal surface of sepals elevated or ribbed, 2.2–3.2 × 0.5–0.6 mm in flower, 4.5–4.8 × 1–1.7 mm in fruit, and longer than the capsule. Capsules oval, 2.5–2.7 × 2.2–2.5 mm, with short stalked glands and spreading to ascending hirsute pubescence; seeds 4, black, ovate, boat-shaped, excavated ventrally, 2.1–2.5 × 1.1–1.2 mm, the margins and ridge corrugated, the dorsal surface pitted and lightly cross-corrugated.

Etymology. *Phacelia higginsii* is named in honor of Larry C. Higgins, who has made a significant contribution to the Arizona Strip flora and assisted in collection of the type collections.

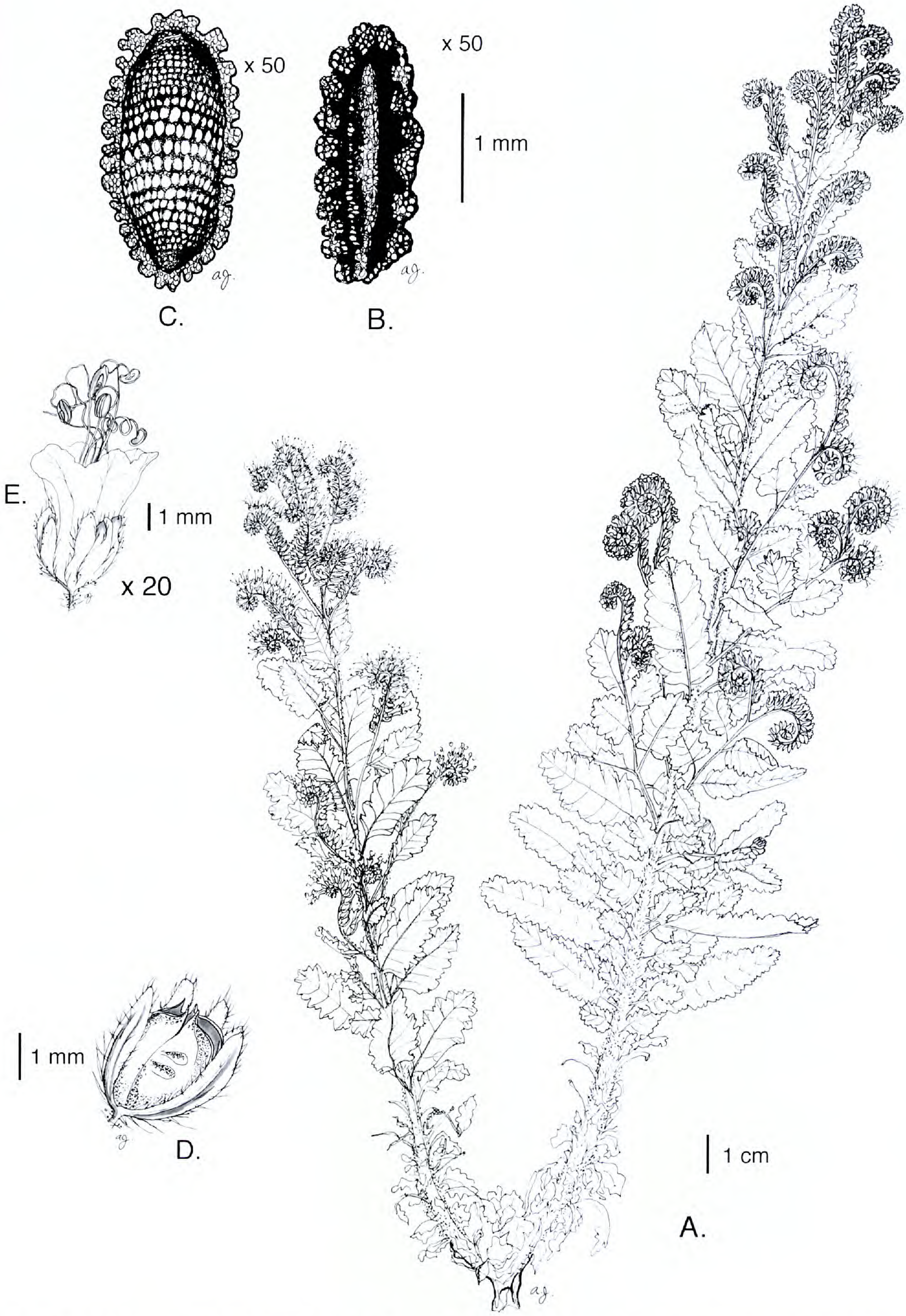

Figure 4. *Phacelia higginsii* N. D. Atwood. —A. Plant. —B. Ventral surface of seed. —C. Dorsal surface of seed. —D. Fruit. —E. Flower. Drawn from the paratype collection, *N. D. Atwood 29892* (BRY).

Relationships. *Phacelia higginsii* is similar to *P. palmeri* in general habit but is less viscid and mephitic, is sometimes perennial in habit (vs. always biennial in *P. palmeri*), is more densely leafy on the main stem, has shorter and narrower sepals (2.2–3.2 × 0.5–0.6 mm vs. 4–5 × 1–1.8 mm), has tubular-campanulate corollas (vs. tubular corollas), and has smaller seeds (2.1–2.5 × 1–1.2 mm vs. ca. 2.5 × 1.5 mm).

Distribution, habitat, and phenology. *Phacelia higginsii* occupies habitat below the Uinkaret and Shivwits Plateau in and between the Whitmore, Parashant, and Andrus Canyon drainages west of Mount Trumbull, in Mohave County, Arizona. Associated plant species are more typical of the Mohave Desert. *Phacelia higginsii* also differs in phenology from *P. palmeri*, with the seeds germinating in the fall or spring, depending on available moisture, and producing a biennial rosette or a rosette from the surviving root stock of the previous year. The rosette remains green through the winter and summer, storing food reserves through these seasons and producing a flowering stem in late summer or fall, depending on the availability of moisture in any given year. Mature seeds are produced in September–October. *Phacelia palmeri* is a much earlier-flowering species, starting as early as mid to late March and producing mature seeds in late April–June. It occurs on red clay and limestone outcrops in canyon bottoms and open slopes of desert shrub communities with *Yucca vespertina* (McKelvey) S. L. Welsh, *Ephedra* L., *Mortonia scabrella* A. Gray, *Brickellia longifolia* S. Watson, *Acacia* Miller, *Krameria parvifolia* Bentham, *Coleogyne ramosissima* Torrey, *Sporobolus cryptandrus* A. Gray, *Eriogonum heermannii* Durand & Hilgard var. *sulcatum* (S. Watson) Munz & Reveal, *Ambrosia confertiflora* DC., *Mentzelia pumila* (Nuttall) Torrey & A. Gray, *Datura wrightii* Regel, and *Chrysothamnus* Nuttall at 3532–3793 ft. (1072–1158 m) elevation in Mohave County, Arizona, north of the Grand Canyon.

Conservation status. The Nature Conservancy global and state rarity ranking for this species should be G1S1, based on the limited range and number of individuals present in the habitat.

Paratypes. U.S.A. **Arizona:** Mohave Co., Arizona Strip, Grand Canyon–Parashant National Monument, Andrus Canyon above rd. crossing, T32.5N, R11W, S1, 11 Oct. 2000, *N. D. Atwood 26249* (ARIZ, ASU, BRY); 7 mi. down Parashant Canyon from summit of Trail Canyon, T33N, R9W, S31, 11 Oct. 2000, *N. D. Atwood 26279* (BRY, MO, NY, RM); Whitmore Canyon, 36°12.23′N, 113°18.25′W, 3 Sep. 2003, *N. D. Atwood, B. Furniss & L. C. Higgins 29727* (ARIZ, ASC, BM, BRY [3], CAS, GH, K, MNA, MO, NY, OSC, RM, RSA, SP, TEX, UC, UNM, US); Parashant drainage in small side canyon W of trail, 36°12.23′N, 113°18.25′W, 18 Sep. 2004, *N. D. Atwood 29892* (ASU, BRY [3], Dixie State College, MO, NY, RM, UNM), *29893* (ARIZ, BM, BRY [3], K, MO, POM, RM, RSA, TEX, UMN).

5. Phacelia hughesii N. D. Atwood, sp. nov. TYPE: U.S.A. Arizona: Mohave Co., Arizona Strip, T34N, R11W, S8, E of Salt Spring S base of Poverty Mtn., 20 Sep. 2001, *N. D. Atwood & L. E. Hughes 27814* (holotype, BRY; isotypes, ARIZ, ASU, BRY [2], Dixie State College, MO, NY, US). Figure 5.

Phaeliae constancei N. D. Atwood affinis sed pubescentia dense hirsutulosa vel hirsuta, non glandulari, foliis lanceolatis vena centrali ventraliter elevata, floribus et sepalis et capsulis minoribus, et seminibus parvis ovalibus et magis corrugatis differt.

Biennial, 3.2 dm tall; stems 1 to several, reddish, freely branched, densely hirsutulous-hirsute, lacking capitate-glandular hairs. Leaves mostly cauline, lanceolate, 0.6–2.3 cm × 2.2–4.3 mm, somewhat revolute but not strongly so, midvein recessed dorsally and prominently raised ventrally, finely hirsutulous, short-petiolate. Inflorescence of lateral and terminal cymes, cymes elongating to 10 cm in fruit; sepals oblanceolate-spatulate, 2.3 mm in flower, 3.5–5.6 × 1.2–1.6 mm in fruit, 1–2 mm longer than the capsule, densely hirsutulous; flowers ca. 4.5 mm, white with purple veins on the tube and lobes, tube 3.5 mm, pubescent externally, lobes ca. 1 mm; stamens and style exserted 4–5 mm, anthers violet, style pubescent to above the middle. Mature seeds 4, black, oval, 1.9–2 × 1.1–1.3 mm, short-elliptic to oval, corrugated around the edge and on one side of the ventral ridge, excavated on both sides of the ridge, pitted.

Etymology. *Phacelia hughesii* is named for Lee E. Hughes, ecologist for the Arizona Strip District of the Bureau of Land Management.

Relationships. *Phacelia hughesii* is most closely related to *P. constancei* but is distinguished from that species by the dense hirsutulous to hirsute nonglandular pubescence; small lanceolate leaves with a raised ventral midvein; smaller flowers, sepals, and capsules; and small, oval, more corrugated seeds.

Distribution and habitat. *Phacelia hughesii* is known only from limestone outcrops of the Harrisburg Formation on the Arizona Strip in Mohave County. Associated with pinyon–juniper, mixed desert shrub communities with *Pinus edulis*, *Juniperus osteosperma* (Torrey) Little, *Chrysothamnus nauseosus* (Pallas) Britton var. *mohavensis* (Greene) H. M. Hall, *Eriogonum elatum* Douglas ex Bentham, *Cordylanthus parviflorus* (Ferris) Wiggins, *Tetradymia canescens* DC., *Sporobolus cryptandrus*, *Artemisia bigelovii* A. Gray, *Abronia fragrans* Nuttall ex Hooker, *Lepidium montanum* Nuttall, *Gutierrezia sarothrae* (Pursh) Britton & Rusby, *Oenothera caespitosa* Nuttall var. *stellae* S. L. Welsh, *Mentzelia integra* (M. E. Jones) Tidestrøm, *Camissonia exilis* (P. H. Raven) P. H. Raven, *Atriplex canescens*, *Yucca baccata* Torrey, and *Parthenium ligulatum* (M. E. Jones) Barneby at 4660–5938 ft. (1423–1812 m) elevation.

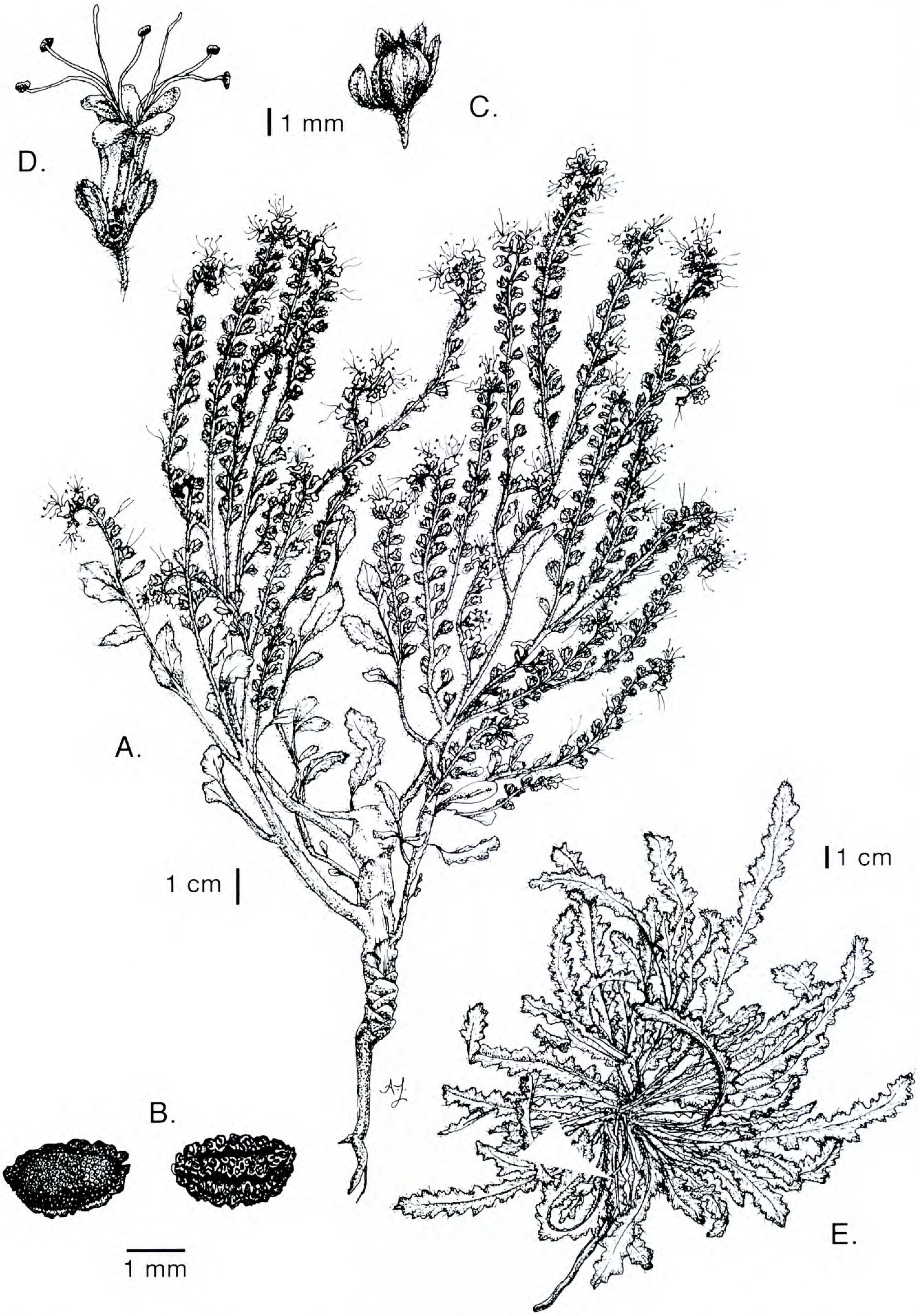

Figure 5. *Phacelia hughesii* N. D. Atwood. —A. Plant. —B. Seed, dorsal (left) and ventral (right) views. —C. Fruit. —D. Flower. —E. Rosette. Drawn from the type collection, *N. D. Atwood & L. E. Hughes 27814* (BRY).

Conservation status. The Nature Conservancy global and state rarity ranking for this species should be G1S3, based on the number of populations and distribution.

Paratypes. U.S.A. **Arizona:** Mohave Co., Arizona Strip, Unikaret rd. on Temple Trail, 8 mi. S of jct. with Navajo Trail, 2 Sep. 1977, *K. Thorne 195* (BRY); ca. 2 mi. from Black Canyon on Clayhole rd., T38N, R7W, S33, 4 Sep. 1977, *K. Thorne 300* (BRY); Tuweep Valley ca. 1 mi. S of Nixon Spring rd. on Tuweep Valley rd., T34N, R7W, S16, 6 Sep. 1977, *K. Thorne 327* (BRY); Sandridge rd. 5 mi. S of Antelope Springs, T40N, R9W, S17, 7 Sep. 1977, *K. Thorne*

336 (BRY); Hack Canyon ca. 35 mi. S of Pipe Springs, T37N, R6W, S26, 36°35.39′N, 112°49.23′W, 15 Oct. 2002, *R. C. Sivinski & B. Weber 5698* (BRY [2]); S of Colorado City Uinkaret Plateau, 36°49.21′N, 113°10.29′W T40N, R8W, S32SE1/4, 20 Aug. 2003, *N. D. Atwood, B. Furniss & L. C. Higgins 29708* (BRY); S of Hat Knoll & N of Spencer Knoll on BLM rd. 1008, 36°33.40′N, 113°5.05′W, 20 Aug. 2003, *N. D. Atwood 29721* (ARIZ, ASU, BM, BRY [2], GH, K, MNA, MO, OSC, RM); on BLM rd. 1008 going W, 36°31.54′N 113°12.95′W, 20 Aug. 2003, *N. D. Atwood, B. Furniss & L. C. Higgins 29723* (BRY, MO, TEX); Hurricane Valley, 36°27.81′N, 113°20.18′W, T36N, R10W, S35, 4 Sep. 2003, *N. D. Atwood, B. Furniss & L. Higgins 29739* (BRY); SE of Diamond Butte, 36°31.93′N, 113°21.63′W, 4 Sep. 2003, *N. D. Atwood, B. Furniss & L. C. Higgins 29743* (ASC, BRY, CAS, NY, OSC, RSA, SP, TEX, UNM, US); head of Hack Canyon S of Pipe Springs, 36°36.67′N, 113°50.78′W, 5 Sep. 2003, *N. D. Atwood & L. C. Higgins 29764* (BRY); W of BLM rd. 5 on rd. 1008 S of Hat Knoll, 36°33.57′N, 113°4.84′W, 17 Sep. 2003, *N. D. Atwood 29883* (BM, BRY [3], CAS, GH, K, MNA, MO, NY, OSC, RM, RSA, SP, TEX, UC, US); 2.5 mi. E of BLM rd. 1008 from jct. of rd. 5, 36°31.67′N, 113°13.51′W, 21 Sep. 2003, *N. D. Atwood 29992* (BRY [3], CAS, MNA, SP, UC, UNM); 3.4 mi. E of rd. 1008 from jct. with rd. 5, 36°11.93′N, 13°13.01′W, 21 Sep. 2003, *N. D. Atwood 29993* (ASC, BRY [3], RSA); WNW of rd. 1001 near old Escalante Historic Trail, 36°38.28′N, 113°14.23′W, 22 Sep. 2003, *N. D. Atwood 30035* (BRY); N of Mt. Trumbull 36°35.35′N, 113°18.02′W, T37N, R9W, S23, 5 May 2004, *N. D. Atwood 30184* (BRY); Honeymoon Trail on BLM rd. 1001, 36°37.12′N, 113°13.97′W, 3 Sep. 2004, *N. D. Atwood & A. Merkley 30667* (BRY); along BLM rd. 1015 betw. Pipe Springs and Mt. Trumbull, 3 Sep. 2004, *N. D. Atwood & A. Merkley 30670* (BRY, MO, NY); Uinkaret Plateau N of Temple Tank S of Antelope Knoll, T38N, R9W, S26, 3 Sep. 2004, *L. C. Higgins 26112* (BRY [2], Dixie State College); Uinkaret Plateau, T40N, R9W, S14, 3 Sep. 2004, *L. C. Higgins 26116* (BRY, Dixie State College); rd. 1015 to Temple Trail, 36°51.82′N, 113°14.04′W, 21 Sep. 2004, *N. D. Atwood 30705* (BRY, MO, NY, OSU, RM, US); BLM rd. 717 N of Mt. Trumbull, 36°28.21′N, 113°2.80′W, 22 Sep. 2004, *N. D. Atwood 30736* (ARIZ, ASU, BM, BRY, CAS, K, MNA, MO, NY, OSC, RM, RSA, SP, TEX, US); Grand Canyon–Parashant National Monument, S of Poverty Mtn., T34N, R11W, S6, 15 Sep. 2004, *L. C. Higgins 26139* (BRY [2], Dixie State College).

6. Phacelia pinkavae N. D. Atwood, sp. nov. TYPE: U.S.A. Arizona: Apache Co., ca. 7 mi. N of Springerville along Hwy. 60 at Jct. 60/180 & 666, T9N, R29E, S13, 24 June 1994, *N. D. Atwood 20092* (holotype, BRY; isotypes, ARIZ, ASU, BRY, CAS, NMC, NY, OSC, UNM, US). Figure 6.

Phaeliae integrifoliae Torrey similis, sed herba pilis nigris capitato-glandularibus dense tecta, seminibus nigris alveolatis, 3–3.4 × 1.2–2.5 mm, in faciebus ambabus cristae ventralis excavatis, crista curva integra vel in latere altero leviter corrugata, superficie dorsali non profunde alveolato-verrucata differt.

Annual or biennial, scented, (1.5)3.1–5.1 dm tall; stems densely covered with short and long, black multicellular capitate-glandular and short nonglandular hairs, leafy, solitary with 3 to 5 lateral branches above the base. Leaves basal and cauline, densely short stipitate-glandular and hirsute-setose, lower leaves oblong-lanceolate, irregularly crenate-dentate or shallowly lobed, the lower petiolate, petiole to 2.2 cm, upper leaves lanceolate, reduced upward, sessile to short-petiolate. Inflorescence of terminal secund racemes, densely capitate-glandular, setose-hirsute, racemes 3 or 4 at the end of each branch, elongating to 1.5 dm in fruit; calyx 2.5–3.3 mm in flower, to 6 mm in fruit, obovate, densely capitate-glandular and hirsute, divided nearly to the base, ca. twice as long as the capsule; corolla tubular, 4.2–4.7 mm, lobes short, sparsely pubescent, pale lavender, fading white in pressed specimens; stamens and style exserted 4.5–5 mm, the filaments glabrous, anthers blue, style bifid 2/3 its length, pubescent from the base to a little above the branching. Capsule 3.5–3.7 mm, oval to oblong, glandular and setose; mature seeds oblong, black, 3–3.4 × 1.2–2.5 mm, excavated on both sides of the ventral ridge, alveolate, the ridge curved, entire to faintly corrugated on one side, dorsal surface shallowly alveolate-warty.

Etymology. *Phacelia pinkavae* is named in honor of the first collector of the species and student of the Arizona flora, Donald J. Pinkava at Arizona State University. His specimen was observed on a visit to ASU years ago, but the exact collection information is not currently available. It was collected north of Springerville, Arizona, and identified as *P. integrifolia*.

Relationships. *Phacelia pinkavae* is similar to *P. integrifolia* but is distinct from this species in having the herbage densely covered with black capitate-glandular hairs and having black, oblong, alveolate seeds 3–3.4 × 1.2–2.5 mm, excavated on both sides of the ventral ridge, the ridge curved, entire to a little corrugated on one side, and the dorsal surface shallowly alveolate-warty.

Distribution, habitat, and phenology. *Phacelia pinkavae* flowers from late May to August. It occurs in volcanic gravels, rocky talus slopes, pumice and andesite soils, grasslands, and grass–shrub communities sometimes with pinyon–juniper. It is associated with *Pinus edulis*, *Juniperus monosperma*, *Gutierrezia sarothrae*, *Mentzelia multiflora* (Nuttall) A. Gray, *M. springeri* (Standley) Tidestrøm, *Brickellia eupatorioides* (L.) Shinners, *Chrysothamnus nauseosus*, *Gilia pinnatifida* Nuttall ex A. Gray, *Bouteloua* Lagasca, *Castilleja* Mutis ex L. f., *Yucca elata* Engelmann, *Verbascum thapsus* L., and *Opuntia whipplei* Engelmann & J. M. Bigelow at 6000–7594 ft. (1830–2300 m) elevation in Apache County, Arizona, east to Santa Fe, Catron, and Sandoval counties, New Mexico.

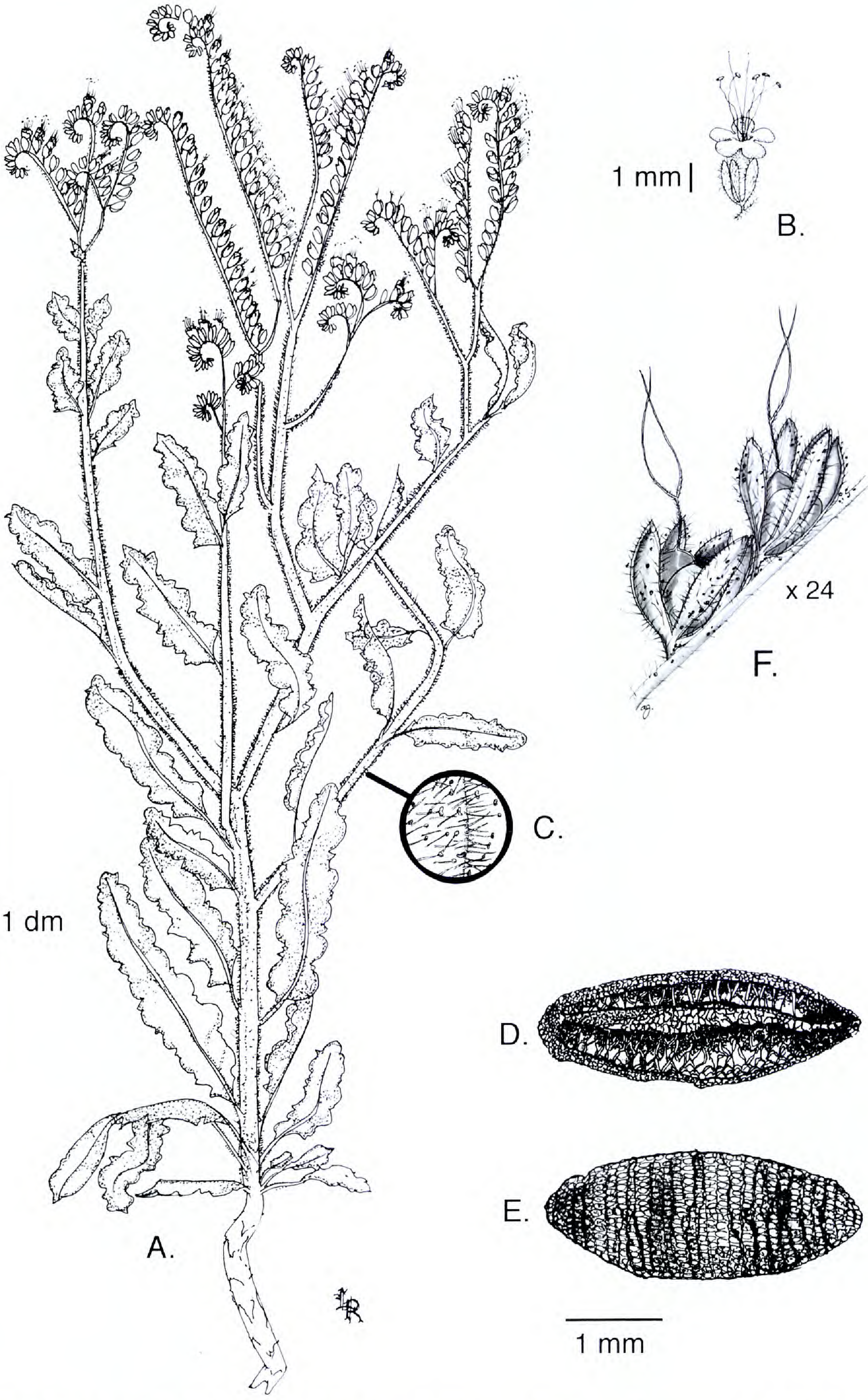

Figure 6. *Phacelia pinkavae* N. D. Atwood. —A. Plant. —B. Flower. —C. Stem pubescence. —D. Ventral seed surface. —E. Dorsal seed surface. —F. Fruit. Drawn from the isotype, *N. D. Atwood 20092* (BRY).

Conservation status. The Nature Conservancy global and state rarity ranking for this species should be G2S3, based on its range.

Paratypes. U.S.A. **Arizona:** Apache Co., ca. 5 mi. N of Concho along Hwy. 180 in gravelly soil, 22 May 1972, *L. C. Higgins 5419* (BRY); betw. Concho and St. Johns, 22 May 1972, *L. C. Higgins 5424* (BRY); just N of Springerville, 22 May 1972, *L. C. Higgins 5425* (BRY); 5.2 mi. NE of Concho along Hwy. 61, 4 June 1974, *N. D. Atwood 6155* (BRY); ca. 4 mi. W of Whiterock along Hwy. 4, 5 June 1974, *N. D. Atwood 6216* (BRY); 30.1 mi. E of Jct. 60/61 on Route 60 W of Springerville in rolling grassland hills on dark volcanic soils, 15 June 1993, *Jon P. Rebman 1890* (BRY); 14.9 mi. E of Jct. 60/61 on Route 60 W of Springerville in grassland–shrub community, 15 June 1993, *Jon P. Rebman 1892* (BRY); 0.4 mi. S of Jct. 191(666)/81 on Route 191(666) W of Lyman Lake and S of St. Johns, 12 July 1993, *Jon P. Rebman & G. Leake 1905* (BRY); T9N, R30E, S18 at jct. of Hwy. 180/60 N of Springerville in gravelly volcanics of shrub–grass community, 6 Sep. 1995, *N. D. Atwood 20600* (ARIZ, ASU, BRY, CAS, NMC, NY, OSC, UNM); jct. of Hwys. 60/180 ca. 6.98 mi. N of Springerville, 6 June 2000, *S. L. Welsh & M. Ralphs 27666* (BRY); Catron Co., 66 mi. W of Socorro along Hwy. 60, 25 June 2002, *L. C. Higgins 23798* (BRY, Dixie State College); just E of Datil, T2S, R10W, S12SE1/4, 25 Aug. 2003, *R. C. Sivinski 5762* (BRY); Catron Co., 66 mi. W of Socorro along Hwy. 60, 25 June 2002, *L. C. Higgins 23798* (BRY). **New Mexico:** Sandoval Co., ca. 4 mi. W of Whiterock along Hwy. 4, 5 June 1974, *N. D. Atwood 6216* (BRY); Santa Fe Co., Hwy. 4 near split ca. 5 mi. E of Los Alamos, T19N, R7E, S21 NW1/4; 35°52.07.3′N, 106°11.49.3′W, 29 June 2003, *R. C. Sivinski 5739* (BRY).

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Astragalus gooraiensis (Fabaceae), a New Species from Jammu and Kashmir, India

Lal Babu Chaudhary

Herbarium, Plant Biodiversity and Conservation Biology Division, National Botanical Research Institute, Lucknow 226 001, India. dr_lbchaudhary@rediffmail.com

ABSTRACT. A new species of *Astragalus* L. (Fabaceae), *A. gooraiensis* L. B. Chaudhary, is described and illustrated from Jammu and Kashmir in India. The new species differs from *A. tibetanus* Bentham ex Bunge in shorter flowers (11–12 mm), shorter and campanulate calyx (4–5 mm), and oblong, straight, and unilocular pods with the stipe more or less equal to the calyx tube.

Key words: *Astragalus*, Fabaceae, India, IUCN Red List, Jammu, Kashmir.

Astragalus L., with about 3000 species worldwide, occurs primarily in cold arid and semiarid mountainous regions of the Northern Hemisphere and South America (Podlech, 1986; Zarre & Podlech, 1997). Recent investigations (Chaudhary, 2005; Chaudhary & Srivastava, 2007) reveal that in India the genus has more than 90 species chiefly distributed in the temperate, alpine, and cold deserts of the Himalayas. However, previous works (Sanjappa, 1992; Chaudhary & Rao, 2002; Kumar & Sane, 2003) have recorded only 75 to 80 species from India. During taxonomic study of Indian *Astragalus*, the author had the opportunity to procure a large number of specimens (BM, CAL) on loan. A wrongly identified but interesting specimen was encountered, collected from Jammu and Kashmir by C. B. Clarke in 1876. Ali (1961, 1977) has determined this specimen to be *A. tibetanus* Bentham ex Bunge. On critical examination, it is identified as a new species, which is described and illustrated below. The new species belongs to section *Hypoglottidei* DC., which was previously represented by a solitary species, *A. tibetanus*, in India.

Astragalus gooraiensis L. B. Chaudhary, sp. nov. TYPE: India. Jammu and Kashmir: Kashmir, Goorai, 8000 ft., 21 July 1876, *C. B. Clarke 29345B* (holotype, BM). Figures 1, 2.

Ab *Astragalo tibetano* Bentham ex Bunge floribus 11–12 mm longis, calyce 4–5 mm longo, campanulato, leguminibus oblongis, rectis, unilocularibus, stipitibus plus minusve tubum calycis aequantibus differt.

Plants ca. 21 cm; stems ca. 16 cm, sparsely pubescent with minute, white, appressed hairs. Stipules greenish, ca. 7 mm, narrowly lanceolate, acuminate at tip, free from the petiole, leaf opposed, connate at base, sparsely pubescent adaxially, glabrous abaxially; leaves 4–6 cm, imparipinnate; petioles ca. 1 cm, like the rachis grooved adaxially; rachis ca. 5 cm; leaflets 5 to 8 pairs, 8–13 × 3–6 mm, oblong, cuneate at base, obtuse at apex, sparsely pubescent with minute, white, appressed hairs abaxially, glabrous adaxially. Inflorescence 6–8 cm, capitate raceme; peduncles 4.5–5.5 cm, longer than subtending leaf, hairy as the stem or slightly blackish at apex; racemes ca. 1.5 cm, 6- to 10-flowered, dense; bracts greenish, 1.5–2.5 mm, longer than pedicels, sparsely ciliate with mixed black and white hairs; pedicels 1–1.5 mm, pubescent with mixed blackish brown and white, appressed hairs; calyx 4–5 mm, campanulate, oblique at mouth, pubescent with minute, brown or white or mixed brown and white, appressed hairs, more pubescent at teeth, tube ca. 3 mm, upper teeth ca. 1 mm, remote, lower teeth ca. 2 mm, crowded; standard 11–12 × 6 mm, obovate to elliptic, emarginate at apex, narrowed toward base; wings ca. 10.5 mm, slightly shorter than the standard, lamina ca. 6.5 × 2 mm, oblong or narrowly obovate, slightly curved toward tip, obtuse at apex, auricle straight, oblong-rhomboid, subobtuse, ca. 1 mm, claw ca. 4 mm; keel ca. 9 mm, shorter than wing petals, lamina ca. 4.5 × 3 mm, incurved toward apex, obtuse, auricle minute, triangular, acute, claw ca. 4.5 mm; staminal tube ca. 6 mm, filaments free in upper 2.5–3 mm; ovary ca. 2.5 mm, densely pubescent with white, appressed hairs, with a stipe ca. 2 mm; style ca. 5 mm, incurved above; stigma capitate, glabrous. Pods greenish, 11–13 × 4 mm, oblong, straight, turgid, unilocular, pubescent with minute blackish brown, appressed or subappressed hairs, stipe ca. 3 mm, ± equal to calyx tube. Seeds not seen.

Distribution and preliminary assessment of conservation status. Endemic to India (Jammu and Kashmir). An intensive survey of *Astragalus* in alpine regions of the Himalayas in India and study of the flora of neighboring countries as well as many regional flora (Baker, 1876; Ali, 1977; Grierson & Long, 1987) show that *A. gooraiensis* is confined only to Goorai region in Jammu and Kashmir. The new species is

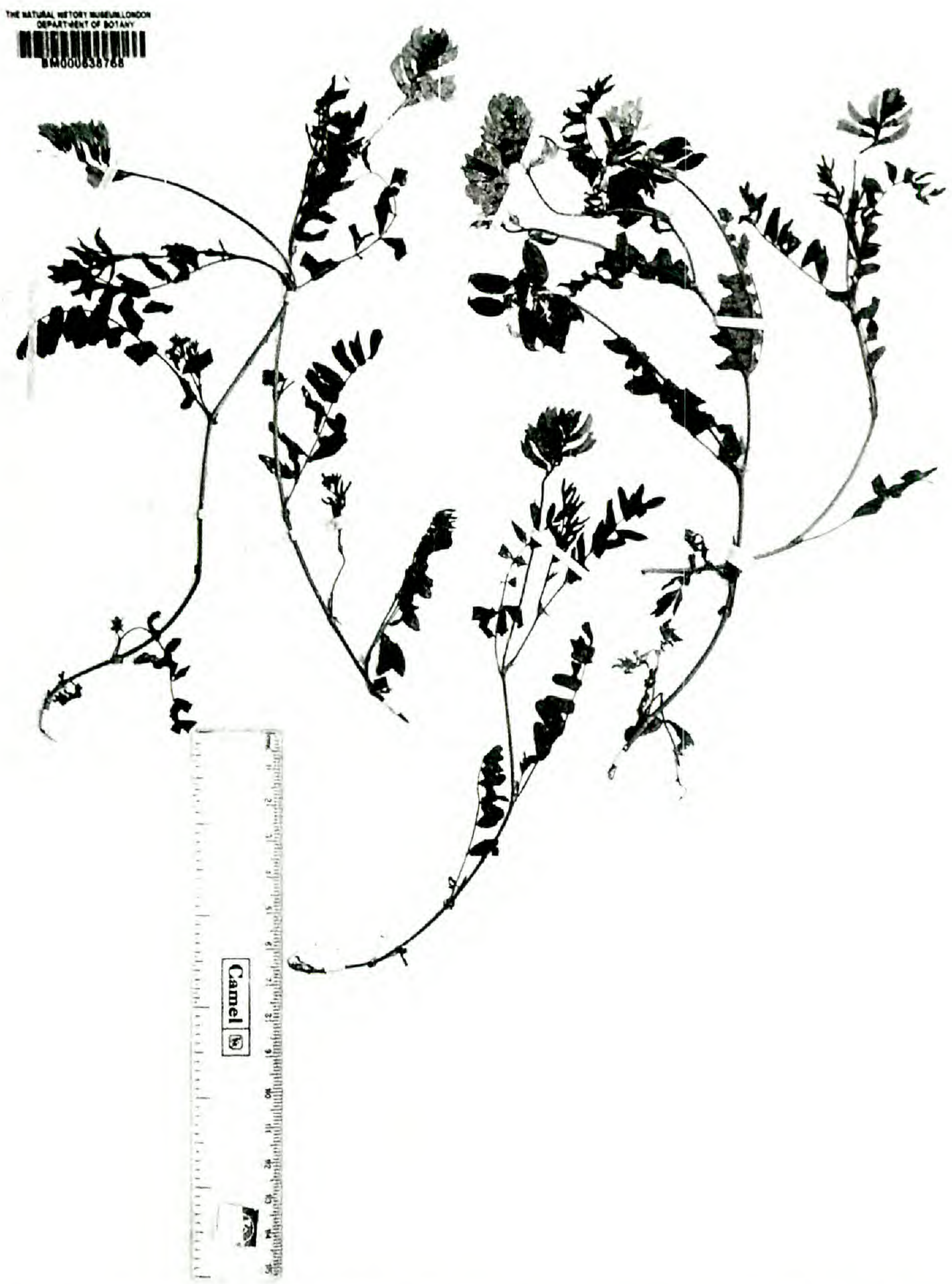

Figure 1. Holotype specimen (*C. B. Clarke 29345B*, BM) of *Astragalus gooraiensis* L. B. Chaudhary.

known from only two specimens representing a single collection made in 1876. The study of specimens housed at various herbaria (BM, BSD, BSHC, CAL, CDRI, K, LBG, LWG) reveals that the new species has not been recollected after type collection. It indicates that the species is not common in the field and is perhaps confined to a very restricted locality. The type locality is also not intensively explored in recent times due to insurgency and terrorist activities prevailing in that area. The main threat to the species in this area is grazing along with other herbaceous plant species. Based on the preliminary observation it should therefore be regarded as CR (Critically Endangered) according to IUCN criteria (IUCN, 2001).

Phenology. Flowering and fruiting in July.

Relationships. In gross morphology *Astragalus gooraiensis* resembles *A. tibetanus*, but distinctly differs in its 11–12 mm flowers; campanulate, 4–5 mm long calyx; and pods that are oblong, straight, and unilocular with a stipe more or less equal to the calyx tube. In *A. tibetanus*, the flowers are 15–20 mm; the calyx is tubular and 6.5–8 mm long; and the pods are linear, slightly falcate, grooved dorsally, and completely bilocular with the stipe shorter than the calyx tube. The differences between the two species have been provided in the key couplet below.

1a. Flowers 15–20 mm long; calyx 6.5–8 mm long, tubular; pods linear, slightly falcate, grooved dorsally, bilocular; stipe shorter than calyx tube . . . . . *Astragalus tibetanus*

1b. Flowers 11–12 mm long; calyx 4–5 mm long, campanulate; pods oblong, straight, turgid, unilocular; stipe more or less equal to calyx tube . . . . . *Astragalus gooraiensis*

Paratype. INDIA. **Jammu & Kashmir:** Kashmir, Goorai, 8000 ft., 21 July 1876, *C. B. Clarke 29345A* (CAL).

Acknowledgments. The author is thankful to the Director, National Botanical Research Institute, Luck-

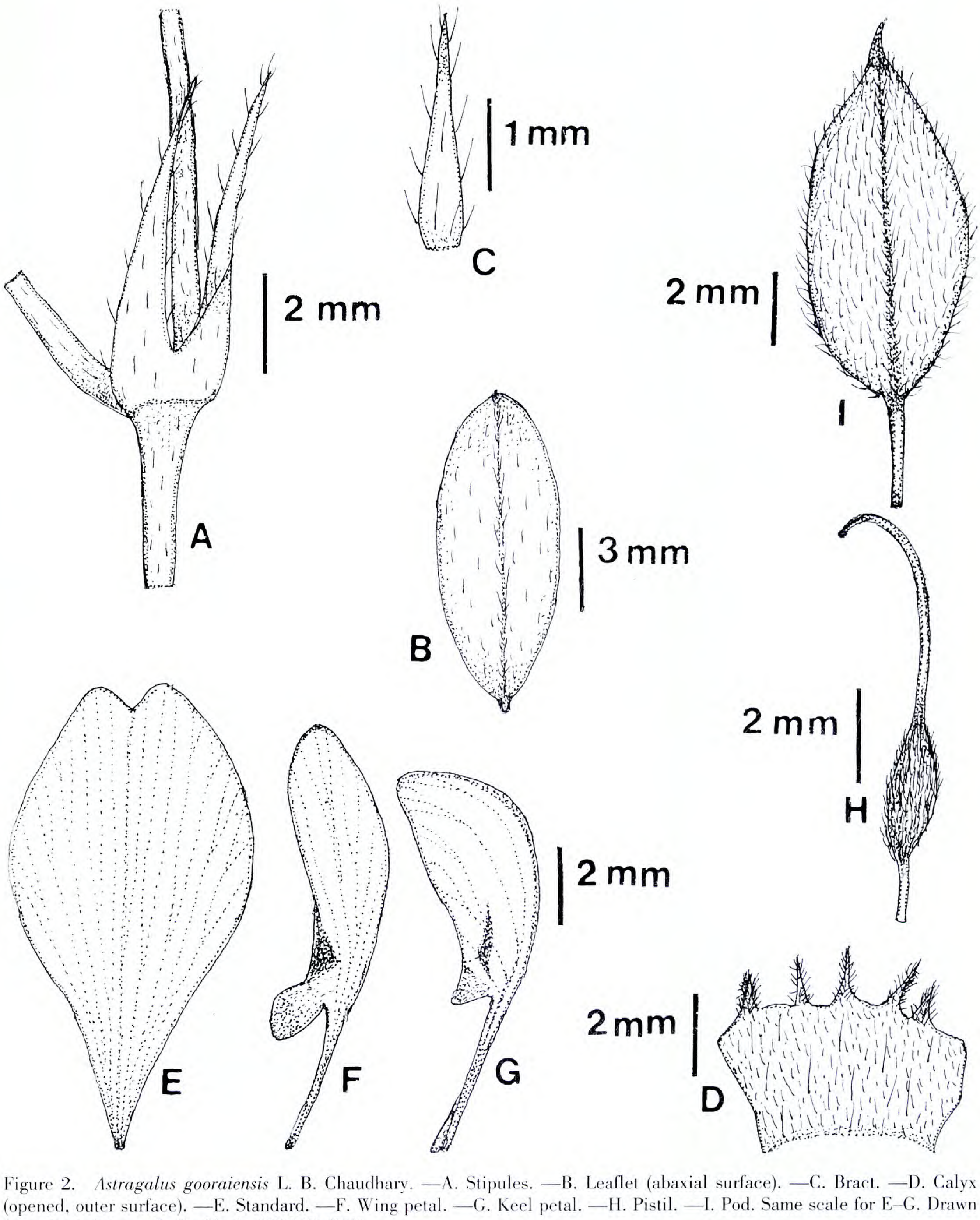

Figure 2. *Astragalus gooraiensis* L. B. Chaudhary. —A. Stipules. —B. Leaflet (abaxial surface). —C. Bract. —D. Calyx (opened, outer surface). —E. Standard. —F. Wing petal. —G. Keel petal. —H. Pistil. —I. Pod. Same scale for E–G. Drawn from the holotype, *C. B. Clarke 29345B* (BM).

now, for providing facilities, and to the Department of Science and Technology (DST), Government of India, New Delhi, for financial support. The curators of the herbaria mentioned in the work are also acknowledged for providing permission to study and for loaning the specimens. I am also grateful to the reviewers, especially S. Zarre and Victoria C. Hollowell, scientific editor, for their valuable comments and suggestions.

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A New Species of *Gyrostipula* (Rubiaceae, Naucleeae) from Madagascar

Erik Emanuelsson
Swedish Museum of Natural History, P.O. Box 50007, SE-10405 Stockholm, Sweden.
erik.emanuelsson@nrm.se

Sylvain G. Razafimandimbison
Bergius Foundation, Royal Swedish Academy of Sciences, and Botany Department, Stockholm University, SE-10691, Stockholm, Sweden. sylvain@bergianska.se

ABSTRACT. *Gyrostipula obtusa* Emanuelsson & Razafimandimbison, a new species of Rubiaceae (Naucleeae) from Madagascar, is described and illustrated. The new species differs from its congeners, *G. comorensis* J.-F. Leroy and *G. foveolata* (Capuron) J.-F. Leroy, by its obtuse leaves with more densely spaced lateral (secondary) veins and shorter petioles.

Key words: Cinchonoideae, *Gyrostipula*, IUCN Red List, Madagascar, Naucleeae, Rubiaceae.

The genus *Gyrostipula* J.-F. Leroy (Leroy, 1975) belongs to the subtribe Breoniinae Razafimandimbison & B. Bremer s.l. (Rubiaceae, Cinchonoideae, Naucleeae) (Razafimandimbison & Bremer, 2002). In his *Generic Tree Flora of Madagascar*, Schatz (2001) included *Gyrostipula* in a broad circumscription of the genus *Breonia* A. Richard ex DC. However, *Gyrostipula* has been shown to be a well-defined monophyletic genus, which can easily be distinguished from the other Malagasy Naucleeae by its long, convolute, red, filiform terminal vegetative buds and red placentae that are persistently attached to the septa even after the fruits dehisce and release the mature seeds (Razafimandimbison & Bremer, 2002). The genus has also been demonstrated by Razafimandimbison and Bremer (2002) to be sister to the monospecific Malagasy genus *Janotia* J.-F. Leroy (Leroy, 1975). These sister genera are both diagnosed by their ovules, which are attached side by side to the base of the placentae. Presently, *Gyrostipula* (Leroy, 1975) contains two species, *G. foveolata* (Capuron) J.-F. Leroy, which is confined to but commonly found in the midelevation and humid forests of Madagascar (Capuron, 1972), and *G. comorensis* J.-F. Leroy, which is restricted to the Comoro Islands.

During the taxonomic revision of the Malagasy genus *Breonia* (Razafimandimbison, 2002), the second author discovered at the TEF herbarium in Madagascar a single collection of Naucleeae (*Service Forestier 27633*), which Capuron had initially identified as *Breonia*. However, subsequent morphological investigation conducted by the second author revealed that the collection represents an undescribed species of *Gyrostipula*, which we describe and illustrate herein.

Gyrostipula obtusa Emanuelsson & Razafimandimbison, sp. nov. TYPE: Madagascar. [Est (Nord)], "Environs Nord de Seranampotaka entre Nosiarina et Antsirabe-Nord (route Sambava-Vohémar)," 30 Mar. 1967 (fl), *Service Forestier 27633* (holotype, TEF; isotypes, BR, P). Figure 1.

Haec species a *Gyrostipula foveolata* (Capuron) J.-F. Leroy foliis obtusis, venis lateralibus densioribus et petiolis brevioribus differt.

Tree, 20 m tall, stem 0.60 m thick, young twigs of leafy stems angular, becoming terete with age, glabrous. Stipules of terminal vegetative buds 4–7 mm, red, filiform and convolute, ± twisted when dry, deciduous; petioles 4–8 mm, glabrous; leaf blades 2–5 × 0.8–1.8(2.2) cm, obovate to elliptic, glabrous, apex obtuse, base acute, margin glabrous, entire, lateral (secondary) veins ca. 9 to 12 on each side, spaced 2–4(5) mm apart, attached to primary veins at angles mostly > 60°, tuft-domatia mostly at bases of secondary veins. Inflorescences lateral, solitary, heads 1.2–1.7 cm diam. (including styles); inflorescence axes 9–13 mm, flattened, less thick than the adjacent petioles, glabrous; peduncles visible in part (above the calyx lobes), 0.5 mm; bracts enclosing the young inflorescence calyptra-like, deciduous. Flowers 4-merous; calyx tubes to 1.8 mm, inside and outside pubescent, calyx lobes to 0.2 mm, broadly triangular to truncate, outside often glabrescent in the middle; corolla tubes 3.5–4 × 0.3–0.4 mm, outside glabrous, inside pubescent, corolla lobes ca. 1–1.5 mm, oblong, with a small dorsal subapical swelling, outside pubescent toward apex, inside variously pubescent, often glabrescent with a longitudinal line of hairs in the middle; anthers 0.7 mm, filaments 0.2 mm, flattened; styles 6–7.5 mm, glabrous; stigmas clavate; ovary 2-carpellate, ovules often 7 per locule, pendulous,

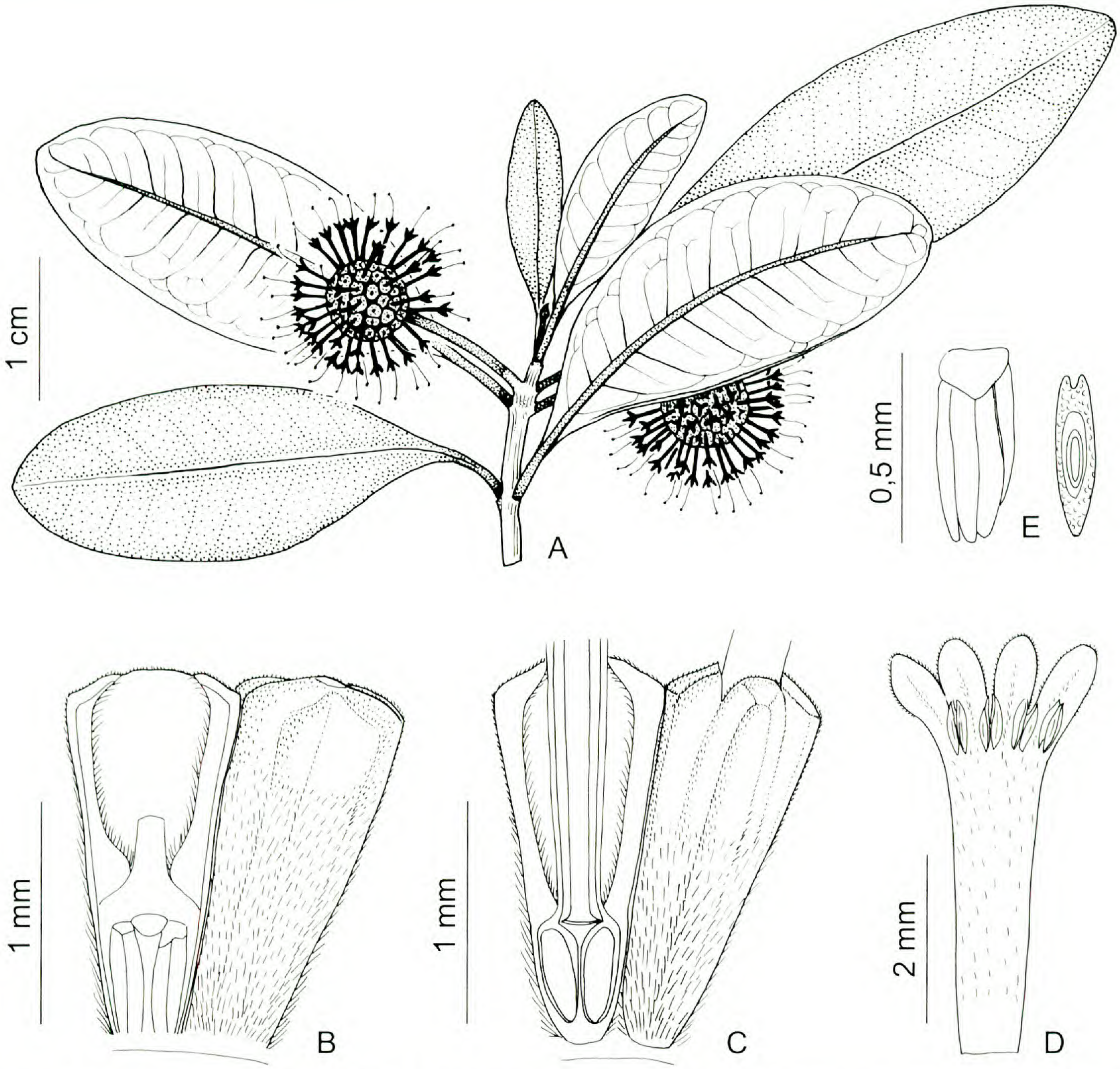

Figure 1. *Gyrostipula obtusa* Emanuelsson & Razafimandimbison. —A. Branch with two inflorescences. —B. Two adjacent flowers: median dissection through flower and ovary, showing a calyx and only one of two carpels (left) and entire calyx (right). —C. Two adjacent flowers: median dissection through flower, showing calyx and corolla tube and the 2-carpellate ovary (left) and entire calyx and part of the corolla tube (right). —D. Opened corolla with stamens. —E. Placentae with four visible ovules attached side by side (left) and single ovule (right). Drawn from the holotype, *Service Forestier 27633* (TEF).

attached side by side from bases of triangular placentae. Fruits unknown.

Distribution and habitat. Only known in Madagascar from north Seranampotaka, between Nosiarina and Antsirabe-Nord (Sambava District, Antsiranana Province); midelevation degraded subhumid forest.

The following key includes the three known species of *Gyrostipula* in Madagascar and the Comoro Islands.

Key to *Gyrostipula* in Madagascar and the Comoro Islands

1a. Leaves 10–18(25) cm long, inflorescence axes 3–6 cm long; Comoro Islands . . . . . *G. comorensis*

1b. Leaves 2–10.5 cm long, inflorescence axes to 1.5 cm long; Madagascar.

2a. Leaf apex acute to acuminate, petiole 10–25 mm long, inflorescence heads 2.1–2.5 cm diam. (styles included) . . . . . *G. foveolata*

2b. Leaf apex obtuse, petiole 4–8 mm long, inflorescence heads 1.2–1.7 cm diam. (styles included). . . . . *G. obtusa*

Discussion. *Gyrostipula obtusa* is readily distinguished from *G. foveolata* by the characters mentioned in the key. The venation also reveals features that are diagnostic. In *G. foveolata* lateral (secondary) veins are ca. 5–10 mm apart and their angles of attachment to primary veins are mostly narrower than 50°. In *G. obtusa* lateral (secondary) veins are ca. 2–4(5) mm

apart and their angles of attachment to primary veins are mostly wider than 60°.

IUCN Red List category. *Gyrostipula obtusa* is known only from the type specimen, suggesting that it is a rare species. However, it is possible that the species still persists within some of the nearest protected areas (e.g., the Marojejy and Anjanaharibe-Sud National Parks), which have similar forest and habitat. The species should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

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Austral Hepaticae 43. *Castanoclobos*, a New Genus of Trichocoleaceae from New Zealand

John J. Engel
Department of Botany, The Field Museum, Chicago, Illinois 60605-2496, U.S.A.
jengel@fieldmuseum.org

David Glenny
Landcare Research, P.O. Box 40, Lincoln 7640, New Zealand. glennyd@landcareresearch.co.nz

Abstract. Presence of a well-developed perianth, ciliate at the mouth, and brown pigmentation necessitate establishment of a new liverwort genus, *Castanoclobos* J. J. Engel & Glenny. The only species, *C. julaceus* (Hatcher ex J. J. Engel) J. J. Engel & Glenny, which is endemic to New Zealand, is described and illustrated. The hepatic genus is retained in the Trichocoleaceae.

Key words: *Castanoclobos*, Hepaticae, IUCN Red List, New Zealand, Trichocoleaceae.

Hatcher (1958) described *Trichocolea julacea* Hatcher based on a plant from Stewart Island, New Zealand. For many years the species was known only from the protologue and "remained somewhat of a mystery plant" (Engel, 1999: 26). Study of the type specimen, together with specimens collected by Engel in New Zealand, formed the basis for a re-evaluation of the taxonomic position of the species by Engel (1999), who placed the plant in *Leiomitra* Lindberg. Schuster (2000, 2001) likewise included the species in that genus. Still, the species remained somewhat of an enigma since it was only known from sterile plants.

Gynoecia came to the attention of the authors by two independent avenues. In the first case Dr. Yin-Long Qui (University of Michigan) provided the senior author fertile material that he collected in Westland, New Zealand. In the second instance the junior author encountered gynoecia-bearing specimens collected by C. D. Meurk (CHR) and H. D. Wilson (see Wilson, 1987) from near South Cape, Stewart Island. These gynoecia-bearing plants provide characters that heretofore were unknown for *Leiomitra* and that facilitate a further assessment of generic placement. Especially noteworthy is the fact that the species is now known to produce a well-developed perianth. That feature, together with several others, argues against retention of the species in *Leiomitra*, and underscores its uniqueness. A new genus is required to contain this unique element, which constitutes a discrete, rather isolated position in the family Trichocoleaceae, and is described as follows.

Castanoclobos J. J. Engel & Glenny, gen. nov.
TYPE: *Leiomitra julacea* Hatcher ex J. J. Engel.

Plantae spongiosae, distincte julaceae, colore badio. Ramificatio irregulariter sympodialis vel pseudodichotoma, ramis omnino frullanioideis. Caulis paraphylliis carens. Insertio foliorum valde succuba. Folia asymmetrice 4–6-loba, paribus loborum ventralibus maximis, lobo dorsali minutissimo, lobis caudatis, marginibus eorum per paria ciliorum opponentium copiose armatis, ciliis repetite dichotome ramosis omnino uniformiter uniseriatis, cellulis eorum elongatis, armatura plerumque adaxialiter orienti ad angulum graduum 90° ad planum folii disposita. Discus asymmetricus, ad sinum dorsalem per 3–4 cellulas altus, ad ventralem per cellulas 5–6 altus, marginibus disci ciliis dichotomose ramosis illis loborum similibus. Cellulae disci parietibus tenuibus, valde elongatae, ad superficiem longi-striolatae. Amphigastria paulo minora quam folia, utrimque anguste connata, quadrifida, disco per cellulas 3–4 alto.

Dioicae. Androecia in caule principali intercalaria, eximie inconspicua; bracteae quoad magnitudinem foliis similes, modice in parte basali ventricosae; numerus antheridiorum per bracteam unicus, stipite biseriato. Gynoecia plusminusve isophylla, in caule principali terminalia, interdum in ramis longis frullanoiodeis disposita; innovationes subflorales nullae; perigynia caulina praesentia seriebus tribus bractearum et bracteolarum in eis insertis, bracteis bracteolisque seriei intimae similibus, usque 0.35–0.45 longitudinis tri- vel quadrifida, lobis longe ciliiformibus. Perianthium praesens, bene effectum, dense pilis brevibus simplicibus vel ramosis obtectum, tricarinatum, carina tertia ventrali, ore non vel leniter contracto ciliis rigidis praedito.

Plants spongy, distinctly julaceous, with all sides appearing as a mass of interwoven cilia, loosely creeping, chocolate brown (the shoot tips light green), the shoots to 2 mm wide. Branching irregularly sympodial to pseudodichotomous, the leading axis soon losing its dominance, the main shoot and branches alike in vigor, the branches strictly of *Frullania*-type. Stem lacking paraphyllia, hidden on all sides by interwoven leaf cilia. Rhizoids occasional, in tight bundles, from stem at immediate base of underleaves, the tips often branched. Leaves widely

spreading, but with lobes arching toward shoot apex, rather closely imbricate, distinctly succubously (almost longitudinally) inserted, the lamina twisted: ventral sector of leaf oriented parallel with substrate, the dorsal sector of leaf antically assurgent and the dorsal margin seen on edge, the leaves obtrapezoidal to subreniform, asymmetrically 4–6-lobed, the ventral pair of lobes largest, the dorsal lobe smallest. Lobes caudate, not trifid, the ventral pair of lobes 4–5 cells wide at base (tier immediately above sinus base), then 2–3 tiers of laterally juxtaposed cells basal to the uniseriate row of 6–10 cells; cells of uniseriate row cylindrical, with dilated septa, 13–25 μm wide, 62–98 μm long, the cells toward base of uniseriate row rather thick walled, the cells becoming progressively smaller and less thick walled toward lobe apices, the surface of penultimate and terminal cells striolate-papillose, that of the remaining cells finely striolate; terminal cell of uniseriate row somewhat tapered, 10–12 μm wide, 68–90 μm long, slightly thick walled in the tip; margins of lobes copiously armed with pairs of opposing cilia, the cilia of lobes and sinus bases repeatedly dichotomously branched, the branches of each dichotomy stiffly diverging, but the armature primarily directed adaxially and oriented at right angles to the leaf plane, the leaf thus appearing to have a stiffly ciliate adaxial leaf surface, the cilia ultimately forming a densely interwoven dendroid crown to the leaf; marginal cilia of lobe uniformly uniseriate throughout, the cells elongate, rather thick walled, the surface of cells toward base of cilium striolate, the surface of cells toward and including terminal cell striolate-papillose; sinus bases plane and not reflexed. Disc slightly convex, asymmetric, 3 to 4 cells high at dorsal sinus, 5 to 6 cells high at ventral sinus (from base to sinuses); margins of disc with dichotomously branched cilia similar to those of lobes, the cilia often adaxially displaced and lying at right angles to the disc plane. Cells of disc thin walled, strongly elongated, aligned in somewhat irregular tiers, in lamina middle 22–26 μm wide × 84–108 μm long; surface markedly long striolate, with only a few papillae. Underleaves somewhat smaller than leaves, narrowly connate on both sides, cuneate, quadrifid, the marginal armature similar to leaves and likewise forming a mass of interwoven cilia; disc 3 or 4 cells high. Asexual reproduction lacking.

Dioecious. Androecia intercalary on main shoot, notably inconspicuous, the bracts in ca. 3 pairs, of similar size to leaves, transversely inserted at dorsal end, moderately ventricose in basal sector, the dorsal margin somewhat dilated and inflexed, the disc a little higher than leaves (6 cells high at dorsal sinus), the bracts otherwise as in leaves; antheridia large for bract size, 1 per bract, the stalk biseriate. Gynoecia isophyllous, terminal on main shoot, sporadically on long *Frullania*-type branches, subfloral innovations lacking; stem perigynium present, 2(3)-stratose, obscurely and bluntly trigonous, with 3 inserted series of bracts and bracteoles, the bracts and bracteoles each with their lamina erect, clasping the perianth and closely adhering to its contours but with the lobes moderately but stiffly spreading, each series ensheathing the perianth, the lateral margins mutually connivent but not fused; bracts and bracteoles similar in size and form, deeply convex (dorsal view), those of first and second series subequal in size, those of innermost series similar to bracts and bracteoles of series immediately below (second series) except for the slightly smaller size, the less-armed lobe bases, and the greater number of simple cilia of the lamina margins, the bracts and bracteoles of innermost series symmetrically narrowly ovate, 3- to 4-lobed to 0.35–0.45, the lobes long ciliiform, terminating in a uniseriate row of 7 to 11 elongated, thick-walled cells with slightly swollen septa and a finely striolate surface, the lobe bases entire or with 1 to 2 pairs of opposing simple or branched cilia, the lamina distinctly inflated at base, the margins with simple (or somewhat less common) once-forked cilia, the 2 cilia of this fork subequal. Perianth present and well developed, the transition from stem perigynium to perianth not evident in either external or internal aspect, the outer surface of the entire sporophyte protective device (stem perigynium + perianth) densely invested with short, simple or branched hairs (the inner face of the perianth with a few hairs distally, but smooth in median and basal sectors), the perianth rather sharply trigonous distally (the third keel ventral), the intervening sulci deep, the perianth tapered toward mouth, the mouth not or at most feebly contracted, fringed with stiff cilia, the cilia comprised of 2 to 4 elongated (to 9:1) thick-walled cells with a distinctly papillose surface, the tip cell tapering to a rather sharp summit; perianth unistratose (or very locally bistratose) in distal and median sectors; shoot calyptra apparently lacking, the unfertilized archegonia at or near calyptra base (gynoecia seen only in a state soon after fertilization). Sporophyte unknown.

Castanoclobos julaceus (Hatcher ex J. J. Engel) J. J. Engel & Glenny, comb. nov. Basionym: *Leiomitra julacea* Hatcher ex J. J. Engel, Novon 9: 26, fig. 1. 1999. *Trichocolea julacea* Hatcher, Trans. Roy. Soc. New Zealand 85: 245. figs. 30–36. 1958, nom. inval. (Art. 37). TYPE: New Zealand.

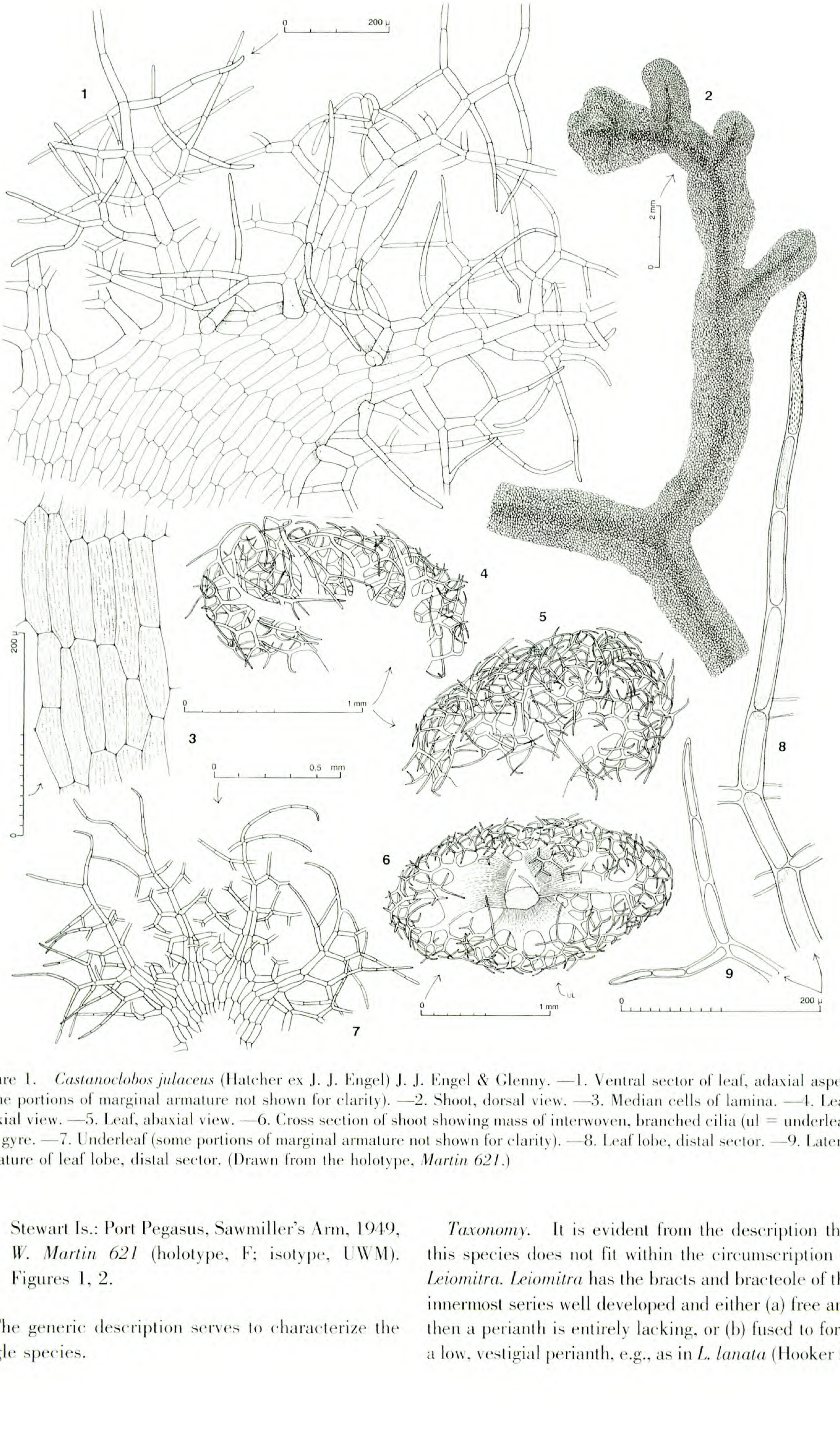

Figure 1. *Castanoclobos julaceus* (Hatcher ex J. J. Engel) J. J. Engel & Glenny. —1. Ventral sector of leaf, adaxial aspect (some portions of marginal armature not shown for clarity). —2. Shoot, dorsal view. —3. Median cells of lamina. —4. Leaf, adaxial view. —5. Leaf, abaxial view. —6. Cross section of shoot showing mass of interwoven, branched cilia (ul = underleaf) of 1 gyre. —7. Underleaf (some portions of marginal armature not shown for clarity). —8. Leaf lobe, distal sector. —9. Lateral armature of leaf lobe, distal sector. (Drawn from the holotype, *Martin 621*.)

Stewart Is.: Port Pegasus, Sawmiller's Arm, 1949, *W. Martin 621* (holotype, F; isotype, UWM). Figures 1, 2.

The generic description serves to characterize the single species.

Taxonomy. It is evident from the description that this species does not fit within the circumscription of *Leiomitra*. *Leiomitra* has the bracts and bracteole of the innermost series well developed and either (a) free and then a perianth is entirely lacking, or (b) fused to form a low, vestigial perianth, e.g., as in *L. lanata* (Hooker f.)

Figure 2. *Castanoclobos julaceus* (Hatcher ex J. J. Engel) J. J. Engel & Glenny. —1. Gynoecium, ventral view (br = bract); note isophyllous condition. —2. Innermost bracts, and in middle, bracteole. —3. Bracteole (left) and bract from second series. —4. Lobe of innermost bract, the surface striolae shown in part. —5. Perianth, cross section through distal portion. —6. Portion of perianth mouth with surface papillae shown in part (sh = surface hair). —7–10. Hairs of perianth surface. —11. Antheridial stalk. (Drawn from *Y. Qiu & Braggins NZ-03128.*)

R. M. Schuster. In *Leiomitra* the distal portion of the sporophyte is protected by the calyptra together with bracts and/or a low, vestigial perianth. The gynoecium of *Castanoclobos*, on the other hand, has a well-developed perianth that is rather sharply trigonous distally (Fig. 2: 5) and has a ciliate mouth (Fig. 2: 1, 6). The perianth is subtended by a stem perigynium with three series of bracts and bracteoles inserted on it (Fig. 2: 1). As noted in Engel (1980: 17), "vestigial stem perigynia have independently developed in a wide variety of unrelated taxa. In this condition, there is a swollen region of axial proliferated tissue at the perianth base on which several or all of the bracts and bracteoles are inserted." Also, in *Castanoclobos* the calyptra is low, with unfertilized archegonia at or near its base, and affords protection of the sporophyte only in the early development stages (i.e., it does not protect the distal portion of the sporophyte as in *Leiomitra*). The form of the gynoecium in *Castanoclobos* is similar in several respects to, for example, that of *Clasmatocolea puccioana* (De Notaris) Grolle of southern South America, a plant that is discussed and illustrated by Engel (1980, fig. 50: 1, see p. 17). In that species a stem perigynium subtends a perianth and has two cycles of bracts and bracteole inserted on it, the innermost and the adjacent series below. In *Castanoclobos* the surface of the entire sporophyte protective device (stem perigynium + perianth) is densely covered with short, simple or branched hairs (Fig. 2: 1, 7–10) versus a smooth coelocaule surface in *Leiomitra*. Also, these plants differ from not only *Leiomitra*, but all other Trichocoleaceae, in developing brownish secondary pigments.

One could argue for placement of *Castanoclobos* in the Pseudolepicoleaceae based on presence of a trigonous perianth that is ciliate at the mouth, and brownish secondary pigments. However, rather than unnecessarily distend the Pseudolepicoleaceae with inclusion of *Castanoclobos*, it appears preferable to place the genus as the basalmost member of the Trichocoleaceae. The trichocoleoid gametophyte architecture, especially the form of the leaf lobes with branched cilia, and the complete lack of ventral-intercalary branching support that placement. In the Pseudolepicoleaceae, on the other hand, leaf lobe and lamina margins are entire or spinose dentate or, if ciliate, the cilia are nearly always simple and never branched. Also, ventral-intercalary branching is very common in Pseudolepicoleaceae.

Castanoclobos underscores the close affinity between Pseudolepicoleaceae and Trichocoleaceae. In fact, some authors (e.g., Schuster, 1980, 1984, 2000, 2001) would treat the complex in a single family, the Trichocoleaceae, with four subfamilies, including subfam. Blepharostomatoideae, subfam. Chaetocoleoideae, subfam. Temnomoideae, and subfam. Trichocoleoideae.

Distribution and IUCN Red List category. *Castanoclobos julaceus* is known only from Stewart Island (the type collection and from near South Cape, New Zealand) and the Cascade ultramafic moraine in southern Westland. The species should be classified as DD (Data Deficient) according to IUCN (2001) criteria.

Additional specimens examined. NEW ZEALAND. **Stewart Island:** Near South Cape, 200 m, *Meurk & Wilson s.n.* (CHR), 160 m, *Meurk & Wilson s.n.* (CHR). **South Island:** Westland, 19 km on Jackson River Rd. from Arawata River Bridge, 140 m, *Y. Qiu & Braggins NZ-03128* (F).

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A New Species of *Rhaphiolepis* (Rosaceae) from Hainan Island, China

Fan Qiang, Liao Wen-bo, and Miau Ru-huai*

State Key Laboratory of Biocontrol, School of Life Sciences, Sun Yat-sen University, Guangzhou 510275, People's Republic of China. *Author for correspondence: lsslwb@mail.sysu.edu.cn

Abstract. *Rhaphiolepis wuzhishanensis* W. B. Liao, R. H. Miau & Q. Fan (Rosaceae) is described as a new species from Mt. Wuzhishan of Hainan Island in China. The new species is most similar to *R. umbellata* (Thunberg) Makino in morphology, but differs in having more flowers (70 to 100) in the inflorescence, more stamens (ca. 25), styles connate to the midpoint, smaller fruits (5–7 mm diam.), and a longer, densely rusty tomentum. The ecological and conservation status of the new species is also assessed.

Key words: China, Hainan Island, IUCN Red List, *Rhaphiolepis*, Rosaceae.

Hainan Island is located in southern China and known as a part of the Indo-Burma biodiversity hotspot, with some 4094 indigenous vascular plant species in an area of 33,900 km^2 (Myers et al., 2000; Liao et al., 2002, 2003). Since 1999, we have conducted extensive botanical surveys on Hainan Island in order to elucidate the composition and biodiversity of the local rainforests and the zonal differentiation of typical floristic elements of southern China (Liao et al., 2001; Tang et al., 2002). During this investigation, the new species *Rhaphiolepis wuzhishanensis* W. B. Liao, R. H. Miau & Q. Fan was collected in Mt. Wuzhishan, the highest mountain on Hainan Island, with an altitude of 1867 m.

The genus *Rhaphiolepis* Lindley comprises nine species, distributed in eastern and southeastern Asia (Robertson, 1991). Four species were recorded previously in Hainan Island, i.e., *R. indica* (L.) Lindley, *R. lanceolata* H. H. Hu, *R. ferruginea* F. P. Metcalf (Kuau & Yu, 1974; Lu et al., 2003), and *R. salicifolia* Lindley (Chen, 2000). Compared with those species, the new species we collected shows some obvious differences, and further studies indicate that the new species is morphologically similar to *R. umbellata* (Thunberg) Makino. To distinguish *Rhaphiolepis* species in Hainan Island, a revised identification key is provided (based on Chun, 1965; Lu et al., 2003).

A Revised Key to *Rhaphiolepis* Species in Hainan Island, China

1a. Leaves abaxially, petiole, and pedicel densely rusty tomentose.
  2a. Leaf margin entire, blade abaxially densely rusty tomentose, not glabrescent; stamens 15; styles connate only at the base . . . . *R. ferruginea*
  2b. Leaf margin coarsely serrate apically, blade abaxially densely rusty tomentose when young, soon glabrescent; stamens (22 to)25(to 30); styles connate to the midpoint . . . . . *R. wuzhishanensis*
1b. Leaves, petiole, and pedicel glabrous or only abaxially slightly tomentose or pubescent.
  3a. Stamens 15, as long as, shorter, or longer than petals.
    4a. Leaf blade ovate or oblong, rarely obovate or oblong-lanceolate, 2–8 × 1.5–4 cm . . . . . *R. indica*
    4b. Leaf blade narrowly lanceolate, 3–9.5 × 0.5–1.4 cm . . . . . *R. lanceolata*
  3b. Stamens 20, shorter than petals . . . . *R. salicifolia*

Rhaphiolepis wuzhishanensis W. B. Liao, R. H. Miau & Q. Fan, sp. nov. TYPE: China. Hainan Island: Mt. Wuzhishan, near summit, 1830 m, 18°53′820″N, 109°42′103″E, 5 Aug. 2005, *Q. Fan 6087* (holotype, SYS; isotype, MO). Figure 1.

Species nova *Rhaphiolepidi umbellato* (Thunberg) Makino similis, sed floribus pluribus et densioribus, staminibus (22 ad)25(ad 30) (non 15 ad 20), stylis ad partem media non solum ad basim connatis, fructibus minoribus differt.

Evergreen shrub or small tree, 2–4 m high, much branched; branchlets terete, densely rusty tomentose when young, later glabrescent, older branches stout, black or dark black. Leaves crowded at tips of branchlets; petiole 0.5–1.1 cm, narrowly decurrent-alate; stipules subulate, 2–3 mm; leaf blades elliptic-ovate or elliptic, 3–6 × 1.8–3 cm, thickly coriaceous, adaxially white tomentose, denser along midrib and secondary venation, abaxially densely rusty tomentose when young, soon glabrescent, tomentum 1.5–1.7 mm, midrib elevated on both surfaces, secondary venation camptodromous, 8 to 11 veins on each side of midrib, slightly impressed adaxially, margin coarsely serrate apically, distinctly revolute, apex obtuse to slightly acute, base cuneate-decurrent. Inflorescences in terminal panicles, 70- to 100-flowered, 7–10 cm long, 6–7.5 cm diam.; peduncle and pedicels densely

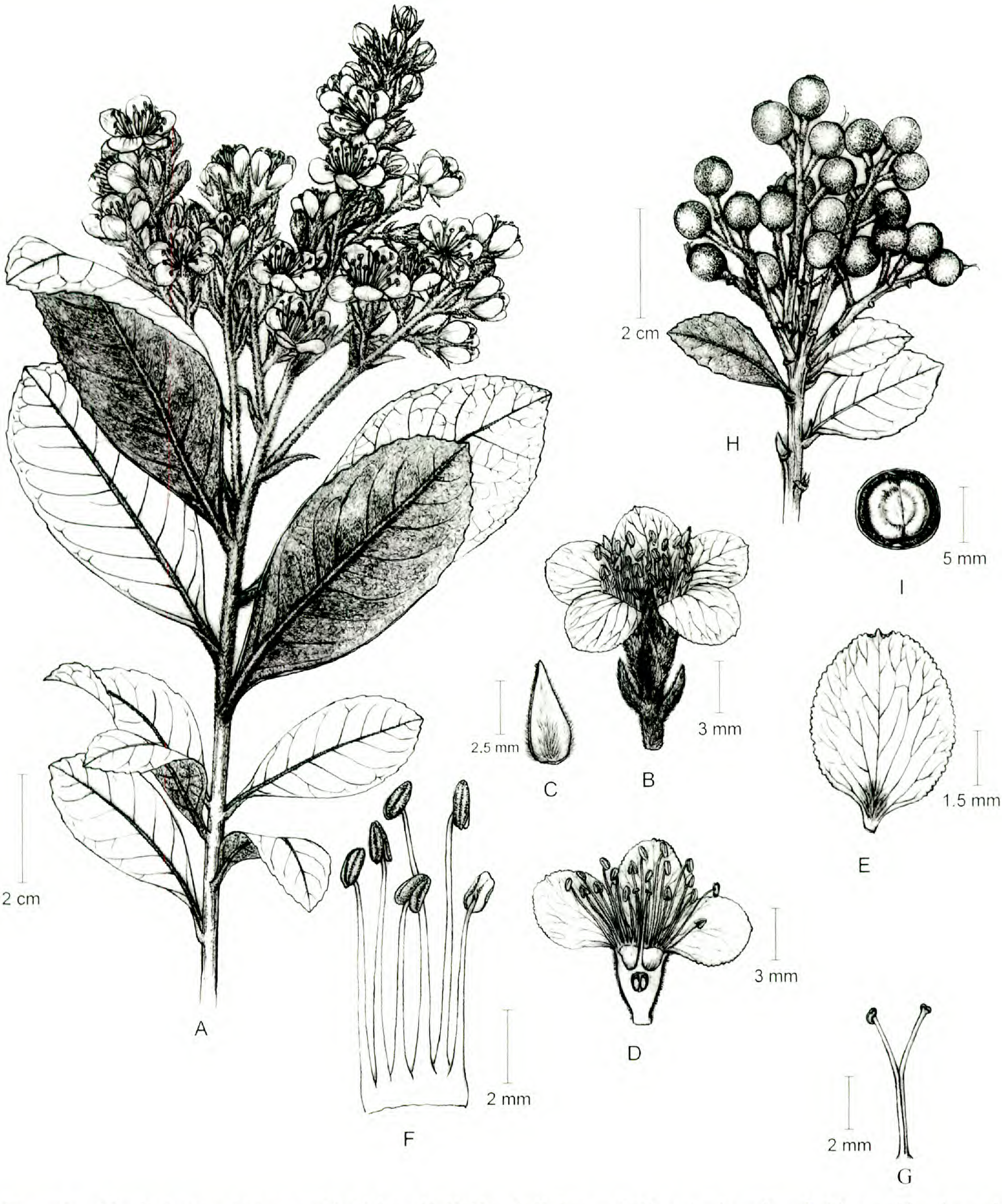

Figure 1. *Rhaphiolepis wuzhishanensis* W. B. Liao, R. H. Miau & Q. Fan —A. Flowering branch. —B. Flower with calyx and bracts. —C. Calyx lobes, adaxial view. —D. Flower, in longitudinal section. —E. Petal. —F. Stamens. —G. Style. —H. Fruit branch. —I. Fruit, in longitudinal section. A–G from *Q. Fan 6087* (holotype, SYS); H, I from *Q. Fan 6085* (paratype, MO). Drawn by Yunxiao Liu.

rusty tomentose; bracts and bractlets narrowly ovate-triangular or lanceolate, 4–6 mm, both surfaces rusty tomentose. Flowers 8–10 mm diam. Hypanthium campanulate, ca. 5 × 5 mm, abaxially densely rusty tomentose, 5-lobed, the calyx lobes lanceolate, 3–5 × 1.5–2 mm, rusty tomentose on both surfaces; petals white, obovate-spatulate or rotund, 6–8 × 4–7 mm, slightly pubescent basally, margin irregularly crenulate, apex obtuse and mucronulate; stamens (22 to)25(to 30), 4–9 mm, alternately unequal in length, the longer ones as long as or slightly longer than the petals; ovary ovoid, 1.5–2 mm, 2-loculed, with 2 ovules per locule; styles 2(to 3), glabrous, connate from base to middle;

ovules ovoid, ca. 0.8 mm. Pome black at maturity, globose, 5–7 mm diam., glabrous.

Phenology. Flowering in January, July, and August; fruiting in August.

Distribution and habitat. Currently known only from Mt. Wuzhishan on Hainan Island, China, in mountain forests, on cliffs, or at summits at altitudes from 1600 to 1860 m.

Systematic relationships. The most typical characters of *Rhaphiolepis wuzhishanensis* are the stamen number of (22 to)25(to 30) and the style that is connate from base to middle; these characters distinguish the taxon from all the other species of *Rhaphiolepis*, which have 15 to 20 stamens and a style connate only at base. Based only on the number of stamens and the densely rusty tomentum below the leaves, the species might be mistaken as *Eriobotrya* Lindley. However, there are no persistent sepals on the mature fruits of *R. wuzhishanensis*. Moreover, the new species is a much-branched shrub or small tree no more than 4 m high, with leaves with curved lateral veins, a glabrous style, and a 2-loculed ovary. On this basis, the new species is treated as *Rhaphiolepis*. In fact, with sterile specimens, the new species is readily distinguished from the other four species in Hainan Island (i.e., *R. indica*, *R. salicifolia*, *R. lanceolata*, and *R. ferruginea*) by its densely rusty tomentum on young branchlets and the abaxial leaf surfaces. Furthermore, the new species is the only *Rhaphiolepis* occurring above 1600 m on Hainan Island.

The closest relative of *Rhaphiolepis wuzhishanensis* on morphological grounds could be *R. umbellata*. They share many similar characters, e.g., habit, the revolute leaves at the top of branchlets, the elliptic-ovate or elliptic leaf blades, and inflorescences with rusty tomentum. *Rhaphiolepis wuzhishanensis* can be readily separated from *R. umbellata*, however, by its greater number of stamens (on average 25 vs. 20), the styles connate to the midpoint (vs. connate only at base), the number of flowers per inflorescence (70 to 100 vs. 10 to 50), smaller fruits (5–7 mm vs. 7–10 mm diam.), and longer tomentum (1.5–1.7 mm vs. 0.6–0.7 mm). In addition, *R. umbellata*, occurring in Zhejiang, Taiwan, and Japan (Lu et al., 2003), is geographically distinct from *R. wuzhishanensis*. In conclusion, the morphological differences and the discontinuous distribution provide sufficient evidence for treating *R. wuzhishanensis* and *R. umbellata* as separate species.

Conservation status and IUCN Red List category. Our investigation shows that *Rhaphiolepis wuzhishanensis* is highly localized, known only from Mt. Wuzhishan, with no more than 1000 mature individuals in an area of about 10 km^2. We assess the conservation status as EN (Endangered) according to IUCN Red List criteria (IUCN, 2001). Fortunately, although it has a graceful figure and beautiful flowers, it has not yet been commercially exploited and introduced as garden plants, unlike *R. umbellata* and *R. indica*, because it is found in mountain forests above 1600 m, far away from villages. However, Mt. Wuzhishan is one of the most famous scenic spots in Hainan Island; therefore, the habitat of *R. wuzhishanensis* is more or less disturbed by tourists. Our investigation in Mt. Wuzhishan is still in progress, and it is anticipated that more plants and new sites for *R. wuzhishanensis* will be discovered. Moreover, study of the level of genetic diversity of the new species is currently under way in the laboratory using molecular markers. Detailed strategies will be suggested for the conservation and management of the species by these studies.

Paratypes. CHINA. **Hainan Island:** Mt. Wuzhishan, in mtn. forests, 1700 m, 30 July 2003, *Q. Fan 2793* (SYS); Mt. Wuzhishan, near summit, 1820 m, 5 Aug. 2005, *Q. Fan 6085* (IBSC, MO, SYS); Mt. Wuzhishan, in forests, 1780 m, 20 Jan. 2007, *X. G. Shi 3142* (SYS).

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Tetracera forzzae (Dilleniaceae), uma Nova Espécie para a Zona da Mata de Minas Gerais, Brasil

Claudio Nicoletti de Fraga

Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Rua Pacheco Leão, 915, 22460-030, Jardim Botânico, Rio de Janeiro, RJ, Brasil. cnfraga@jbrj.gov.br

Gerardo A. Aymard C.

UNELLEZ-Guanare, Programa de Recursos Naturales Renovables, Herbario Universitario (PORT), Mesa de Cavacas, Estado Portuguesa, Venezuela, 2350. gaymard@cantv.net

Resumo. *Tetracera forzzae* Fraga & Aymard (Dilleniaceae), uma nova espécie da Zona da Mata de Minas Gerais, Brasil, é descrita, ilustrada e comparada com suas espécies afins. A nova espécie aparenta-se com *T. empedoclea* Gilg, *T. portobellensis* Beurling e *T. parviflora* (Rusby) Sleumer, diferindo destas por apresentar tricomas simples e estrelados na face adaxial da folha, sete sépalas além de pétalas com 7–8 mm de comprimento. Esta nova espécie é conhecida apenas da Zona da Mata de Minas Gerais, e é a quarta espécie Neotropical do gênero a apresentar apenas um carpelo. De acordo com os critérios da IUCN Red List das plantas em perigo essa espécie foi enquadrada na categoria em perigo.

Abstract. *Tetracera forzzae* Fraga & Aymard (Dilleniaceae), a new species from Brazil, is described and illustrated, and its relationships are discussed. The new species is morphologically related to *T. empedoclea* Gilg, *T. portobellensis* Beurling, and *T. parviflora* (Rusby) Sleumer; however, *T. forzzae* can be distinguished by its flowers with seven sepals, petals 7–8 mm long, and the leaves with simple and stellate trichomes on the adaxial surface. This new species is known only from the Zona da Mata of the state of Minas Gerais, and is the fourth Neotropical species of this genus so far discovered with a single carpel. According to the criteria of the IUCN Red List of endangered plant species this species is assigned to the EN (Endangered) category.

Key words: Brazil, Dilleniaceae, IUCN Red List, Minas Gerais, *Tetracera*.

Segundo Kubitzki (1970) *Tetracera* L. apresenta duas seções: *Tetracera* e *Akara* Kubitzki. A sect. *Tetracera* é composta por plantas com folhas ásperas, inflorescência tirsóide com 12 a 200 flores, ramificada, ramos laterais multifloros, pétalas obovadas a oblongas de ápice rotundo, enquanto a sect. *Akara* é composta por plantas com folha glabra, inflorescência tirsóide com 1 a 12 flores, ramificada, ramos laterais com 1 a 3 flores, pétalas conspícuas, obcordadas de ápice manifestamente emarginado.

As espécies de *Tetracera* apresentam distribuição Pantropical, sendo reconhecidas 44 espécies para o gênero, 35 incluídas na sect. *Tetracera* distribuídas nas porções tropicais de todos os continentes e nove incluídas na sect. *Akara*, com apenas uma espécie ocorrendo no continente americano (Aymard & Boom, 2002). Das 35 espécies da sect. *Tetracera*, 29 são encontradas na América com 17 distribuídas no Brasil, destas, 15 já haviam sido citadas por Kubitzki (1970), uma foi recentemente descrita por Aymard (2003), e a outra é a nova espécie aqui descrita.

A região da Zona da Mata de Minas Gerais é constituída por florestas estacionais semideciduais, montana e submontana, que se encontram extremamente fragmentadas devido a diversos tipos de impactos antrópicos. Paradoxalmente, poucos estudos florísticos encontram-se desenvolvidos nessa região, como pode ser observado na escassa literatura sobre a flora da região e nas coleções botânicas, que representam muito pouco da diversidade das matas mineiras, depositadas nos herbários nacionais (Menini-Neto et al., 2004).

Tetracera forzzae Fraga & Aymard, sp. nov. TIPO: Brasil. Minas Gerais: Belmiro Braga, 4 km de Fortaleza na estrada para Belmiro Braga, ca. 21°55′55″S, 43°27′00″W, 525 m, 8 mar. 2004, *R. C. Forzza, J. Jardim, E. Lucas, B. R. Silva, S. Edwards, D. Zappi 2985* (holótipo, RB; isótipo, K). Figura 1.

Species nostra *Tetracerae empedocleae* Gilg, *T. portobellensi* Beurling et *T. parviflorae* (Rusby) Sleumer, congeneribus sectionis *Tetracerae*, pedicellis omnibus quam 1 mm brevioribus et carpello unico valde affinis, sed diversa trichomatibus simplicibus atque stellatis parte adaxiali foliorum praesentibus, sepalis 7, petalis 7–8 mm

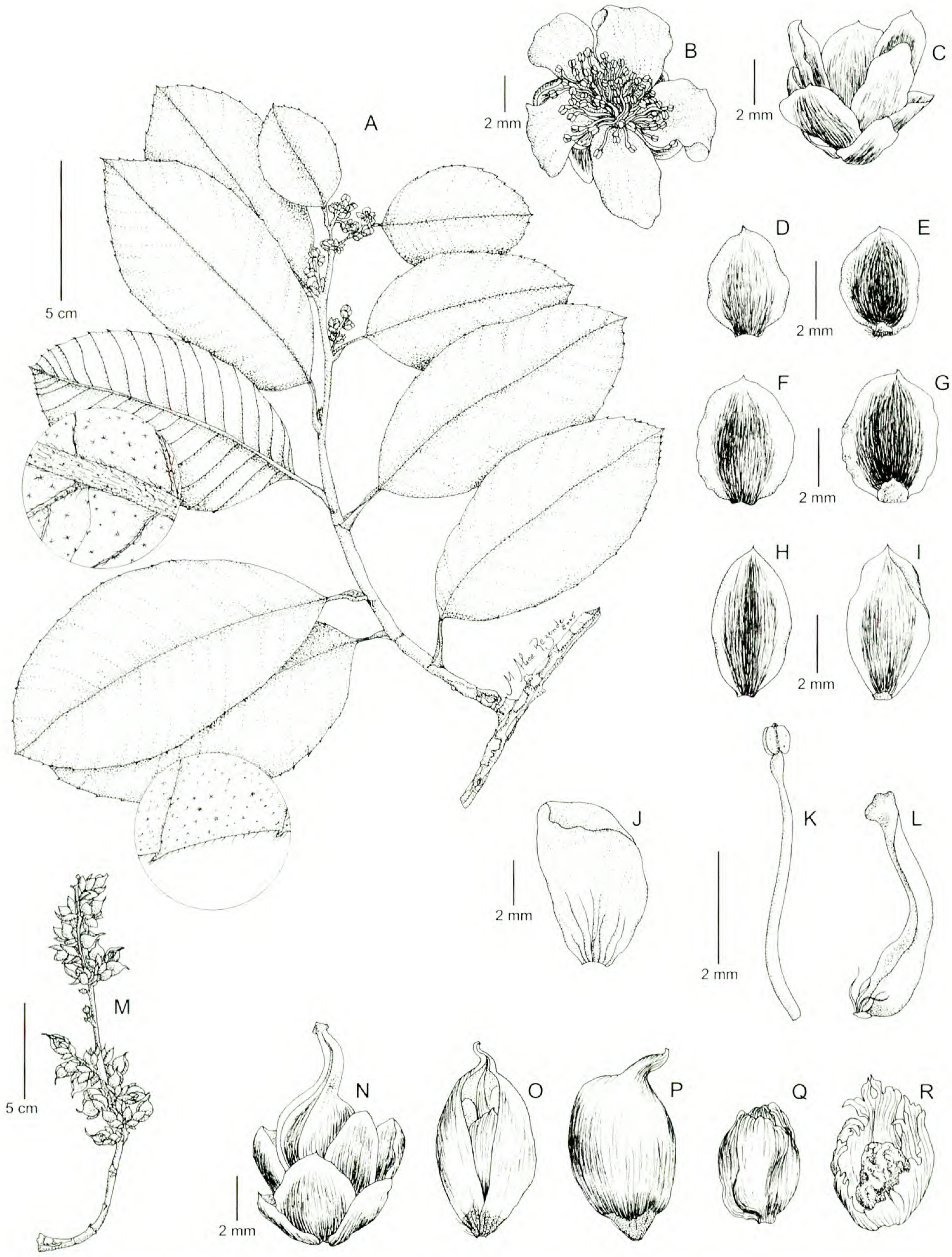

Figura 1. *Tetracera forzzae* Fraga & Aymard. —A. Hábito e inflorescência e detalhes das faces adaxial e abaxial da folha. —B. Flor. —C. Sépalas removidas do conjunto da flor. —D. Sépala externa, face adaxial. —E. Sépala externa, face abaxial. —F. Sépala intermediária, face adaxial. —G. Sépala intermediária, face abaxial. —H. Sépala interna, face adaxial. —I. Sépala interna, face abaxial. —J. Pétala, face abaxial. —K. Estame. —L. Ovário. —M. Infrutescência. —N. Fruto com sépalas persistentes. —O. Fruto, vista frontal à linha de sutura. —P. Fruto, vista lateral à linha de sutura. —Q. Semente recoberta pelo arilo. —R. Semente envolta em arilo aberto. Ilustrações A–L *R. C. Forzza et al. 2985* (K, RB) e M–R *R. M. Castro et al. 305* (RB).

longis, ovario trichomatibus simplicibus basi tantum praesentibus.

Liana, ramos discretamente pilosos, quando maduros glabros, striados, castanho claro. Folha 5–20 × 2.5–9.5 cm, elíptica, cartácea, verde, base obtusa-cuneada, ápice obtuso com apículo, margem inteira na base e crenada no ápice, ciliada; pecíolo 1.2–2.5 cm comprimento, canaliculado, recoberto por tricomas simples em ambas as faces; lamina recoberta por tricomas simples e esparsamente por tricomas estrelados na face adaxial e recoberta por tricomas estrelados na face abaxial, exceto ao longo das nervuras que se apresentam recobertas por tricomas simples, nervuras secundárias 14 a 18, convergentes ligadas a margem, nervuras primárias, secundárias e terciárias evidentes em ambas as faces. Inflorescência, 1.5–3 cm comprimento na antese, atingindo 2–8.5 cm na frutificação, lateral, simples ou ramificada, 5 a 30 flores, recoberta por tricomas simples; pedicelo 0.5–1 mm de comprimento, recoberto por tricomas simples, com brácteas basais 1.5–2 × 2.5–3 mm, recobertas por tricomas simples em ambas as faces, seríceos na face abaxial. Flores hermafroditas com 7 sépalas desiguais em forma e tamanho; sépalas externas 2, 4–5 × 4–4.5 mm, ovadas, sépalas intermediárias 2, 5–6 × 4.5–5.5 mm, elípticas e sépalas internas 3, 6–7 × 4.5–5 mm, lanceoladas, coriáceas, base cuneada, ápice apiculado, recobertas por tricomas simples em ambas as faces, seríceos na face adaxial, castanhas claro; pétalas 5, 7–8 × 4–5.5 mm, elípticas, membranáceas, base cuneada, ápice obtuso, brancas; estames 95 a 115, arranjados em circulo ao redor do ovário; filete 5–6.5 mm comprimento, sinuoso, clavado, glabro, antera ca. 0.5 mm comprimento, globosa, glabra, deiscência longitudinal; gineceu umbonado, ovário unicarpelar, 1–1.5 × 0.5–1 mm, 1-locular, 1-ovulado, com tricomas simples apenas na base; estilete 1.5–2.5 mm comprimento, não ramificado, levemente geniculado, estigma capitado. Fruto monospérmico, 7.5–9.5 × 4–6 mm, oblongo-ovóide, deiscência em 1 sutura longitudinal que se abre do ápice para a base; sementes 4–4.5 × 2–3 mm, rugosas, glabras, vinosas, completamente recobertas por arilo estriado, papiráceo branco.

Etimologia. O nome da nova espécie homenageia Rafaela Campostrini Forzza, botânica do Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, por ter coletado junto com sua equipe grande parte dos materiais tipo desta espécie e por sua importante contribuição para o avanço do conhecimento na Zona da Mata Mineira.

Habitat e distribuição. A nova espécie é conhecida apenas da Zona da Mata de Minas Gerais, que é constituída por florestas estacionais semideciduais, montana e submontana, entre elevações de 500–600 m, florescendo nos meses de março e abril e frutificando em maio. Em função da distribuição restrita na região da Zona da Mata de Minas Gerais, em área de ocupação que somadas não ultrapassam dos 500 km² e em ambientes extremamente fragmentados com registro para menos que cinco localidades, *Tetracera forzzae* é enquadrada na categoria em perigo, conforme IUCN (2001): EN B2ab (ii, iii, iv).

Tetracera forzzae encontra-se inserida na sect. *Tetracera* por possuir folhas ásperas, inflorescência ramificada com mais de 12 flores com ramos laterais multifloros e pétalas obovadas a oblongas de ápice arredondado. Nesta seção a nova espécie aproxima-se de *T. empedoclea*, *T. portobellensis* e *T. parviflora*, por apresentar flores unicarpelares e pedicelo de até 1 mm de comprimento. Entretanto, a nova espécie separa-se de *T. parviflora* e *T. portobellensis* por possuir pedicelo de 0.5–1 mm, sépalas externas e internas maiores que 2 e 3 mm, respectivamente, com tricomas simples seríceos nas faces adaxiais, como em *T. empedoclea*. Em contraste *T. parviflora* e *T. portobellensis* apresentam pedicelos menores que 0.5 mm e sépalas externas e internas menores que 2 e 3 mm, respectivamente, glabras ou estrigosas-glabrescentes nas faces adaxiais. Em relação a *T. empedoclea*, *T. forzzae* separa-se por apresentar ovário glabro, (como em *T. parviflora* e *T. portobellensis*), com pelos apenas na base, enquanto que em *T. empedoclea* o ovário é pubescente.

Além dos caracteres presentes em algumas das espécies do grupo, *Tetracera forzzae* possui tricomas simples e estrelados na face adaxial da folha, sete sépalas, além de pétalas com 7–8 mm de comprimento, enquanto as demais espécies afins apresentam apenas tricomas simples na face adaxial da folha, cinco sépalas (*T. parviflora* e *T. portobellensis*) ou 9–15 sépalas (*T. empedoclea*), além de pétalas menores que 4 mm de comprimento.

Parátipos. BRASIL. **Minas Gerais:** Descoberto, Reserva Biol. da Represa do Grama, 7 maio 2001, *R. M. Castro, P. H. Nobre, F. R. G. Salimenta, V. R. Ameida & B. C. Campos 305* (CESJ, MO, RB); Idem, 2 mar. 2002, *R. C. Forzza, V. R. Scalon & A. V. Lopes 2077* (CESJ, RB); Marliéria, Parque Estadual do Rio Doce, caminho para lagoa do meio, 24 março 2002, *J. R. Stehmann, A. Salino, A. M. Barros & R. C. Mota 3036* (BHCB, RB); Santa Bárbara, Poti, 10 abr. 1997, *G. Pedralli s.n.* (HXBH, MBM).

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A New Species of *Tulipa* (Liliaceae) from Western Iran

Ahmad Ghahreman and Farideh Attar
Central Herbarium, Department of Biology, Faculty of Science, Tehran University, Enghelab Avenue, Tehran, Iran

Farrokh Ghahremaninejad
Department of Biology, Faculty of Science, Tarbiat Moallem University, 49 Dr. Mofatteh Avenue, 15614 Tehran, Iran

ABSTRACT. A new species, *Tulipa faribae* Ghahreman, Attar & Ghahremani-Nejad (Liliaceae), endemic to the Zagros Mountains of Kermanshah province, Iran, is described and illustrated. It is placed in the subgenus *Leiostemones* Boissier due to its lack of trichomes on the filaments and on the base of the tepals, and it appears to be most closely related to *T. schrenkii* Regel, due to its large bulb size, a papery tunic lined inside with some silky appressed hairs, and tepals usually scarlet with a black blotch margined with yellow. The new species differs in having flatter leaf margins, a more robust stem (to 8 mm in diameter), and larger perianth parts (tepals to 100 mm long).

Key words: Iran, Liliaceae, *Tulipa*, Zagros Mountains.

The genus *Tulipa* L. is a member of the Liliaceae family and is traditionally classified in the subfamily Lilioideae. This genus, with nearly 100 species, is distributed from Asia to North Africa (Mabberley, 1997) and contains 35 species in the Iranian Plateau (Iran, Afghanistan, western Pakistan, eastern Iraq, southern Azerbaijan, and southern Turkmenistan), 22 of which are found in Iran, including the new species (Rechinger et al., 1990).

Here we describe a new species in *Tulipa* from the Zagros Mountains in the Kermanshah province of Iran. It belongs to *Tulipa* subg. *Leiostemones* Boissier, which is characterized by a lack of hairs on all of the anther filaments and at the base of the tepals. The subgenus otherwise contains 27 species in five sections in the Iranian Plateau (Rechinger et al., 1990).

Tulipa faribae Ghahreman, Attar & Ghahremani-Nejad, sp. nov. TYPE: Iran. Kermanshah: betw. Paveh & Javanrud (Zagros Mtns.), 1600 m, 15 May 1980, *A. Ghahreman 29931* (holotype, TUH; isotypes, FAR, MO, TUH). Figure 1.

Planta 44–45 cm alta. Bulbus ovoideus, 6.5 cm longus, 2–4 cm crassus. Folia 3 ad 6, lanceolata, glabra. Flos unicus, magnus; tepala rubra, glabra, macula basali nigra. Filamenta nigra, 7–8 mm, glabra; antherae 16–20 mm; ovarium 30 mm longum, flavum, oblongum, glabrum; stylus brevissimus; capsula ignota.

Perennial plant, ca. 44–45 cm high, glabrous, robust, with stem 3–7(–8) mm diam. at lower portion; bulb 6.5 cm tall × 2–4 cm diam.; tunic papery, lined inside with some silky appressed hairs, pale brown, tomentose in upper portion internally. Leaves 3 to 6, lanceolate, glaucous, glabrous, smooth, erect, flat at the margin, attenuate toward apex, not exceeding the flowers; lower leaves up to 20 × 4.5 cm; upper leaves smaller, up to 16 × 1.5–2.5 cm. Flowers solitary, large; perianth segments red, glabrous and black-maculate in the lower third, margined with yellow; outer tepals 5.5–10 × 2–3 cm, broadly elliptic, attenuate toward base in claw, acuminate at the apex; inner tepals shorter, 5.5–7 × 1.5–2 cm, acute or rarely obtuse adaxially, attenuate toward the base in narrow claw; anther filaments black, 7–8 mm, glabrous; anthers olivaceous, 16–20 mm; ovary ca. 30 mm, yellow, oblong, glabrous; style very short (ca. 1 mm long). Fruit not seen.

Phenology. Flowering in May; fruiting most likely June to July.

Etymology. The specific epithet is in honor of the Iranian botanist, Fariba Ghahreman.

Distribution. *Tulipa faribae* is endemic to western Iran and known only from the type locality, with a population of 20 to 25 plants. It is an Irano-Turanian species and grows in a *Quercus* L. forest dominated by *Q. brantii* Lindley.

Relationships. The larger flowers of *Tulipa faribae* easily distinguish it from the other *Tulipa* species distributed in Iran. Morphologically, the closest relative of this species is *T. schrenkii* Regel, which is distributed in western Azarbaijan and Kurdestan provinces, Iran. These two species do not overlap

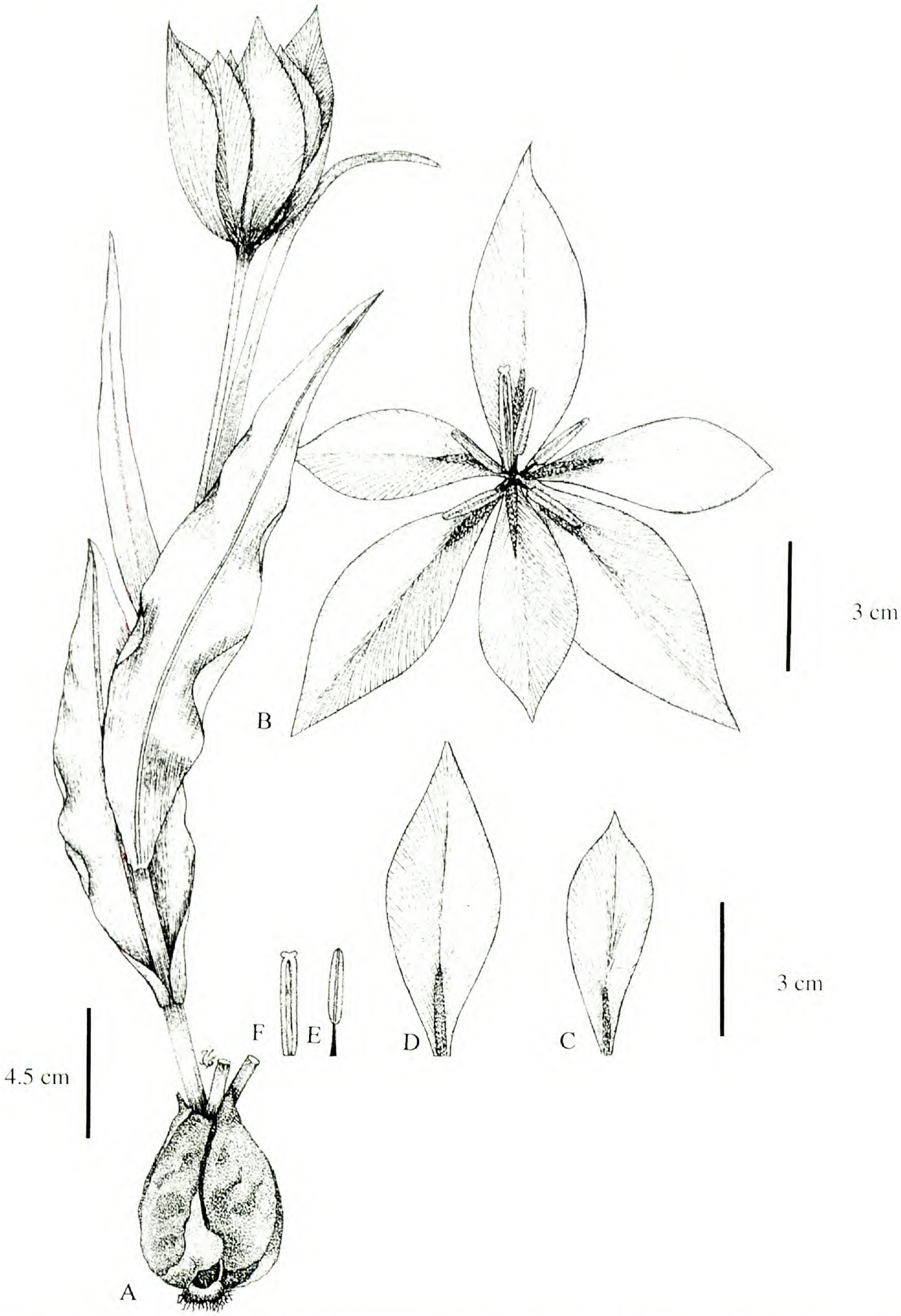

Figure 1. *Tulipa faribae* Ghahreman, Attar & Ghahremani-Nejad. —A. Habit. —B. Flower. —C. Inner tepal. —D. Outer tepal. —E. Stamen. —F. Gynoecium. Drawn from the holotype, *A. Ghahreman 29931*.

geographically, with *T. faribae* located at ca. 34°50″, while *T. schrenkii* is only found as far south as ca. 36°40″ (Rechinger et al., 1990). The new species (seven specimens were examined) differs from *T. schrenkii* in the following: leaves 3 to 6 (vs. 3 to 4), flat at margin (vs. undulate), erect (vs. recurved); stem robust (3–7(–8) mm wide when dry vs. 3.5–4.5 mm); perianth 55–100 × 20–30 mm (vs. 23–58 ×

9–27 mm); and anther length 16–20 (vs. 4–13) mm (Fig. 1).

The other Iranian species of *Tulipa* are distributed between 45 m (Gonbad-e-Kavus, Mazandaran province) and 3600 m (Shirkuh, Yazd province) above sea level, based on information from 257 *Tulipa* specimens from FAR, FUMH, and TUH herbaria. Four of the 22 species of *Tulipa* in Iran are endemic.

Acknowledgments. We thank M. Iranshahr for editing the Latin description.

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New Species and Variety of *Musa* (Musaceae) from Yunnan, China

Markku Häkkinen
Botanic Garden, P.O. Box 44 (Jyrängöntie 2), FI-00014 University of Helsinki, Finland.
markku.hakkinen@kymp.net

Wang Hong
The Herbarium of Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Menglun, Mengla, Yunnan Province 666303, People's Republic of China. wh@xtbg.org.cn

Abstract. One wild banana species, *Musa yunnanensis* Häkkinen & Wang Hong, and one variety of *Musa* L., *M. acuminata* Colla var. *chinensis* Häkkinen & Wang Hong, from Yunnan, China, are newly described and illustrated. These studies are based on observed morphological characteristics in the field and from specimens in various herbaria, and are supported by the existing literature on the Musaceae. A key to *Musa yunnanensis* and related taxa is provided.

Key words: China, *Musa*, Musaceae, Yunnan, wild banana.

The genus *Musa* L. (1753) belongs to the family Musaceae, which includes two other genera, *Ensete* Horaninow (Horaninow, 1862) and *Musella* (Franchet) C. Y. Wu (Franchet, 1889; C. Y. Wu, 1978). The genus *Musa* includes both wild species and cultivated seed-sterile bananas and plantains, with enormous socioeconomic importance. It has been estimated that *Musa* comprises about 70 species (Häkkinen & De Langhe, 2001; Häkkinen & Sharrock, 2002; Häkkinen, 2003a, b, 2004a, b, 2005a, b, 2006a, b, c, 2007; Häkkinen & Meekiong, 2004, 2005; Häkkinen et al., 2005) and over 500 cultivars (Simmonds, 1966; Karamura, 1998; Valmayor et al., 2000, 2002). However, many regions within its center of diversification in Southeast Asia have not been explored systematically, and new species continue to be discovered.

Investigations of Musaceae in Yunnan, China, have shown that there are wild banana populations in both hills and plains below an elevation of 2100 m (Häkkinen, pers. obs.) that tolerate slight frost damage. The following species have been observed in these studies, viz. *Ensete glaucum* (Roxburgh) Cheesman, *Musa acuminata* Colla, *M. balbisiana* Colla, *M. basjoo* Siebolt, and *M. itinerans* Cheesman, as well as other misidentified banana species (Roxburgh, 1814; Colla, 1920; Siebolt, 1830; Cheesman, 1949). However, no previous studies have identified the distinctive new species *M. yunnanensis* Häkkinen & Wang Hong, even though it is widely dispersed throughout the Mekong watershed in Yunnan. The taxon is not mentioned in Chinese Musaceae literature at all, and *M. acuminata* is mentioned only by name (C. Y. Wu, 1978, 1979; H. W. Li, 1978, 1981; Y. Li, 1996; T. L. Wu, 1997; T. L. Wu & W. J. Kress, 2000; Liu et al., 2001, 2002). There are adjacent areas in northeastern India, Myanmar, northern Thailand, and northern Laos where other *Musa* species and varieties similar to *M. yunnanensis* and *M. acuminata* var. *chinensis* Häkkinen & Wang Hong occur; these species have scant mention in the literature.

In one historic report, Cheesman (1948: 28) noted, "In Assam there is a plant represented at I.G.T.A. by I.R. 209 (Mariani), I.R. 211 and I.R. 241, all sent to us by P. H. Carpenter Esq., of the Indian Tea Association at Tocklai Experimental Station. I.R. 209 was collected in the Mariani Range, and is a rather larger plant with larger fruits than the other collections, but all agree in qualitative characters."

Cheesman's report could be considered to be *Musa flaviflora* N. W. Simmonds (Simmonds, 1956a). Cheesman (1948: 28) continued, "If this form has to be separated from *M. acuminata* it will probably prove conspecific with a plant from Tagwin, Myitkyina, Upper Burma (I.R. 183), which at present pending cytogenetic studies, we cannot place. The Tagwin plant closely resembles the Mariani form in bract and flower color and in the early abortion of the male bud—only in this case the bud aborts earlier, usually after producing only a dozen male hands."

However, *Musa yunnanensis* differs in many aspects from the two plants mentioned by Cheesman. The first author has studied Cheesman's samples at Kew and Simmonds' 1956 report from his banana-collecting expedition with photographs. Research in herbaria and the field indicates that *M. yunnanensis* belongs to a larger group of *Musa* species and varieties that with these taxa are affined to an *M. acuminata* group.

Musa acuminata is a highly polymorphic species whose description encompasses most of the described varieties (Colla, 1920; Simmonds, 1956a; De Langhe, 1960; Nasution, 1991). *Musa acuminata* subsp. *burmannica* N. W. Simmonds was described very briefly by Simmonds, but it differs from our newly described variety *chinensis* in many aspects. *Musa acuminata* var. *chinensis* has monoclinous, hermaphroditic female flowers and waxy leaf-sheaths green-yellow in color, without any blotches, which are typical for *M. acuminata* varieties. *Musa acuminata* subsp. *burmannica*, on the other hand, has contrasting characteristics of waxless leaf-sheaths bright green in color with dense purple blotches (Simmonds, 1956a, b).

One notable characteristic common to both *Musa yunnanensis* and *M. acuminata* var. *chinensis* is the presence of monoclinous hermaphroditic female flowers that self-pollinate before the bracts open. Consequently, no hybrids of these two taxa have been observed.

Material and Methods

This paper is based on field observations made by the authors during expeditions in 2005 and 2006 to Yunnan, China. The new species and the new variety are described based on living plants in the field by completing the International Network for the Improvement of Banana and Plantain (INIBAP) *Musa* descriptor list (IPGRI-INIBAP/CIRAD, 1996). The descriptive terms here also follow traditional banana taxonomy (Simmonds, 1962, 1966). Relevant portions of the plant specimens were deposited as holotypes at the herbarium of the Xishuangbanna Tropical Botanical Garden (HITBC), with isotypes at the herbaria of H, IBSC, MO, PE, and QBG. Chromosome numbers were not counted. The complete INIBAP descriptor lists are available at H and at HITBC.

Results and Discussion

1. *Musa yunnanensis* Häkkinen & Wang Hong, sp. nov. TYPE: China. Yunnan: Xishuangbanna, Jinghong Co., Longpa, 1150 m, 13 Nov. 2005, *Wang Hong 8303* (holotype, HITBC [5 sheets]; isotypes, H, IBSC, MO, PE, QBG). Figures 1, 2.

Planta robusta, 1 vel 2 surculis erectis proxime ad stipem, matura usque 5 m alta, pallidoviridis, maculis parvis atropurpureis praedita. Succus aquosus. Foliorum habitus intermedius. Flores basales hermaphroditi, gemmis masculinis lanceolatis, bracteas duas revolutas eceraceas extus rubropurpureas, intus albo-creameas simul tollentibus. Pericarpium maturum flavo-viride.

Plant normal, suckering freely, close to parent plant, 1 or 2 suckers, position vertical; the mature pseudostem to 5 m high, covered with old brown leaf sheaths, underlying color light green with purple-black blotches, waxy, sap watery. Petiole to 70 cm, waxy, petiole margins curved inward with purple-black sparse blotching, petiole bases winged and clasping the pseudostem, very waxy; leaf habit intermediate, lamina to 250 × 60 cm, narrowly elliptic, truncate at the apex, green adaxially, medium green abaxially, appearance dull, surface partially covered with a waxy coating, leaf bases symmetric, both sides rounded and auriculate, midrib dorsally light green, ventrally greenish yellow, with very corrugated lamina. Inflorescence at first horizontal and then falling vertically downward, peduncle to 45 × 4 cm, very pubescent with short hairs, light green to black; sterile bracts 2, deciduous at the opening of the first female flowers; female bud lanceolate, to 40 × 15 cm, bracts red-purple externally and cream internally, sometimes waxy, slightly imbricate, lifting several bracts at a time, revolute before falling. Basal flowers hermaphrodite, to 11 cm, ovary light green, with ovules in 2 rows per locule, the compound tepal ca. 4.5 cm, with 2 prominent thickened keels and hyaline margins, orange to yellow, the lobes orange; the free tepal ca. 3.3 cm, boat-shaped, translucent white with thickened keel and orange lobe; stamens 5, purple with fertile pollen, style ca. 3.2 cm, cream to brown with red spots, stigma ca. 0.9 cm diam., brown-gray. Male bud lanceolate, ca. 12 × 4 cm, bracts red-purple externally, cream internally, with some wax outside, with pointed yellowish apex, lifting several bracts at a time, revolute before falling, the whole bud aborting before fruits mature; male flowers on average 14 per bract in 2 rows, falling with the bract, compound tepal ca. 3.8 cm, cream with thickened keel, ribbed at the dorsal angles, with 5-toothed orange apex, the central lobes smaller than the outer lobes, free tepal ca. 1.6 cm, translucent white, oval, smooth, with thread-like apex; stamens 5, filaments white, anthers purple, anthers and style exserted; stigma cream, ovary arched, pale yellow, without pigmentation. Fruit bunch lax, with 8 hands and 15 fruits per hand on average, in 2 rows, fingers curved toward the stalk, individual fruit ca. 8 cm, curved with a pronounced ridge, pedicel ca. 22 mm, glabrous, fruit apex rounded, without relictual floral remains, immature peel color green, becoming light yellowish green with black blotches and splitting lengthwise at maturity, immature fruit pulp white, becoming white and soft at maturity; seeds nearly flat, wrinkled, ca.

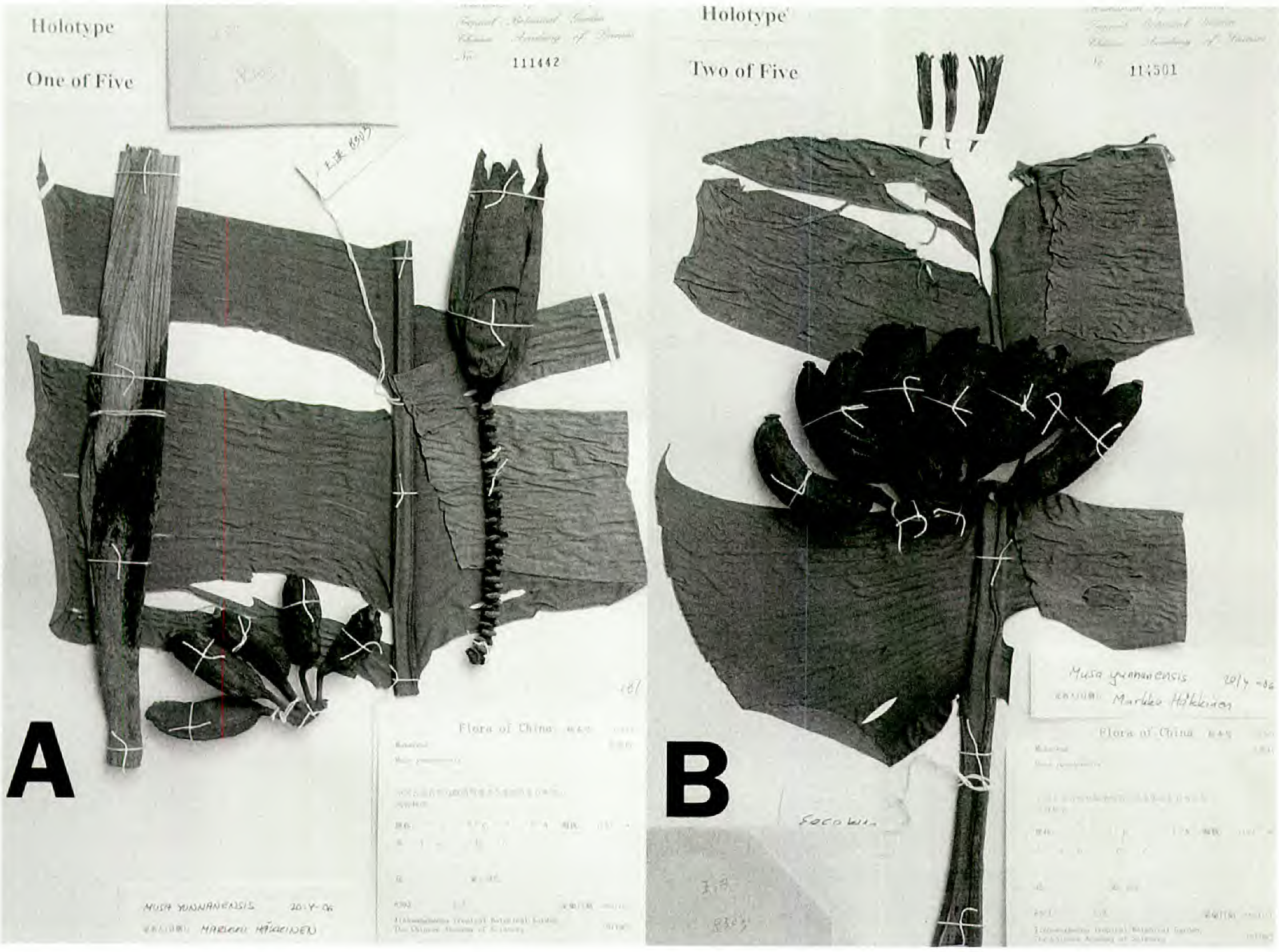

Figure 1. *Musa yunnanensis* Häkkinen & Wang Hong. —A–B. Holotype sheets one (A) and two (B) of five, *Wang Hong 8303* (HITBC).

3.5 mm diam., 80 to 100 seeds per fruit. Chromosome numbers not counted.

Vernacular names. In Chinese, *Musa yunnanensis* is called "Lv Bajiao"—"Lv" means green and "Bajiao" means banana. The Dai name "Boguimen" refers to "Bo" as tree, "Gui" means banana, and "men" means wild (Häkkinen, pers. obs.).

Distribution and habitat. *Musa yunnanensis* grows abundantly in the Mekong River watersheds on slopes from 500–1800 m (Häkkinen, pers. obs.). The plants can tolerate seasonal frosts, which occur from January to February at higher elevations in Yunnan, China. The seeds, which are dispersed by monkeys and bats (Häkkinen, pers. obs.), germinate easily even in shaded environments. However, these young plants then remain dormant for years. When exposed to open light, the young plants thrive. This species is called the tree banana by the local people because it can grow among the tree branches under forest canopy, with some plants 1–2 m high. The plants appear dormant under the closed canopy, but as the canopy opens, they rapidly develop. *Musa yunnanensis* is cultivated commonly at higher elevations up to 2100 m, and the stems are used as animal fodder (Häkkinen, pers. obs.).

Notes. The first author tentatively used the name *Musa yunnanesis* without describing it a few years ago (Häkkinen, unpublished data) when seeds came to commercial markets from Yunnan.

Paratypes. CHINA. **Yunnan:** Xishuangbanna, Jinghong Co., July 2005, *M. Häkkinen, 500, 501, 502, 503* (HITBC); Mengla, Xiola Hwy., 10 Nov. 2005, *Wang Hong 8289* (HITBC); Mengla, Xiaola Hwy., 10 Nov. 2005, *Wang Hong 8290, 8291, 8292* (HITBC); Mengla, Menglun, Yinchang, 11 Nov. 2005, *Wang Hong 8300* (HITBC); Jinghong, Longpa, 13 Nov. 2005, *Wang Hong 8302* (HITBC); Jinghong, 14 Nov. 2005, *Wang Hong 8305* (HITBC); Jinghong, Mt. Mengsong, 29 Nov. 2005, *Wang Hong 8363* (HITBC); Jinghong to Menglun, Mang Me, 15 Dec. 2005, *Wang Hong 8377* (HITBC); Jinghong, A Ke Lao Zhai, 20 Dec. 2005, *Wang Hong 8379* (HITBC); Dehong, Yinjiang, Mulai River, 8 Jan. 2006, *Wang Hong 8382* (HITBC); Dadugang, Hill, 25 Jan. 2006, *Wang Hong 8386* (HITBC); Xishuangbanna Trop. Bot. Garden, 6 Mar. 2006, *He Li-qing 40* (HITBC).

2. Musa acuminata Colla var. **chinensis** Häkkinen & Wang Hong, var. nov. TYPE: China. Yunnan: Simao Distr., Jiancheng Co., Lixian Jang River, close to Vietnam border, 380 m, 7 Dec. 2005, *Wang Hong 8369* (holotype, HITBC [5 sheets]; isotypes, H, IBSC, MO, PE, QBG). Figures 3, 4.

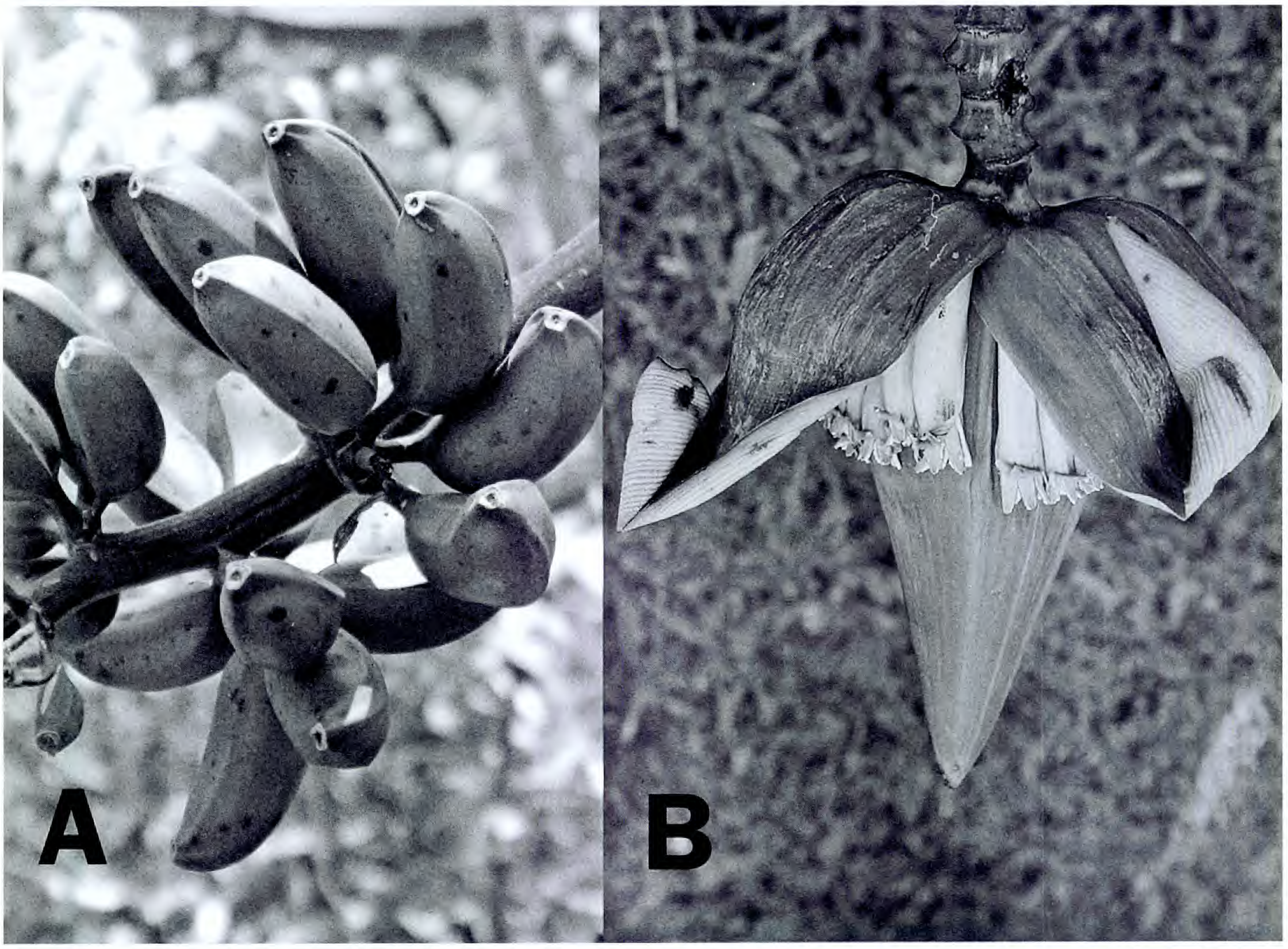

Figure 2. *Musa yunnanensis* Häkkinen & Wang Hong. —A. Fruit bunch. —B. Male flowers. Photos by Häkkinen (A) and Wang Hong (B) from Mengla, Xiola Hwy., Yunnan, China.

Planta intermedia, 3 ad 5 surculis erectis proxime ad stipem, matura usque 4 m alta, pallidoviridis, maculis parvis roseis praedita. Succus lacteus ac non aqueus. Foliorum habitus intermedius. Flores basales hermaphrodi, gemmis masculinis lanceolatis, bracteam unam, revolutam, ceraceam, extus lazulinopurpuream, intus atrorubram tollentibus. Pericarpium maturum luteum.

Plant intermediate, suckering freely, close to parent plant, 3 to 5 suckers, position vertical; the mature pseudostem to 4 m, covered with old brown leaf sheaths, underlying color light green with small rose color blotches, waxy, sap milky. Petiole to 75 cm, some wax, petiole margins wide and erect with dark brown large blotching, petiole bases winged and not clasping the pseudostem; leaf habit intermediate, lamina to 205 × 60 cm, narrowly elliptic, truncate at apex, green-yellow adaxially, medium green abaxially, appearance dull, wax on both surfaces, leaf bases symmetric, both sides rounded, midrib dorsally green, ventrally light green, with few stripes on lamina. Inflorescence semi-pendulous and then falling vertically downward, peduncle to 40 × 3.8 cm, glabrous and medium green in color; sterile bracts 2, persistent at the opening of first female flowers; female bud lanceolate, to 28 × 10 cm, bracts blue-purple externally and dark red internally, some wax, bract apex obtuse, cream colored, heavily imbricate, lifting as several bracts at a time, revolute before falling. Basal flowers hermaphrodite, ca. 7 cm, the compound tepal ca. 4 cm, with 2 prominent thickened keels with hyaline margins, cream colored, lobes orange, free tepal ca. 3.3 cm, boat-shaped, translucent white with thickened keel; stamens 5, anthers brown, with fertile pollen; ovary light green, arrangements of ovules in 2 rows per locule, style ca. 3.3 cm, cream; stigma brown, ca. 0.6 cm diam. Male bud lanceolate, ca. 18 × 6.5 cm, bracts blue-purple externally and dark red internally, some wax, bract apex obtuse, cream colored, lifting one bract at a time, revolute before falling; male flowers on average 17 per bract in 2 rows, falling with the bract, compound tepal ca. 3.6 cm, cream with thickened keel, ribbed at the dorsal angles, with 5-toothed orange apex, the central lobes smaller than the outer lobes, free tepal ca. 2.1 cm, translucent white, rectangular, smooth, with triangular apex; stamens 5, filaments cream, anthers gray, anthers and style exserted, stigma orange, ovary arched, cream, without pigmentation.

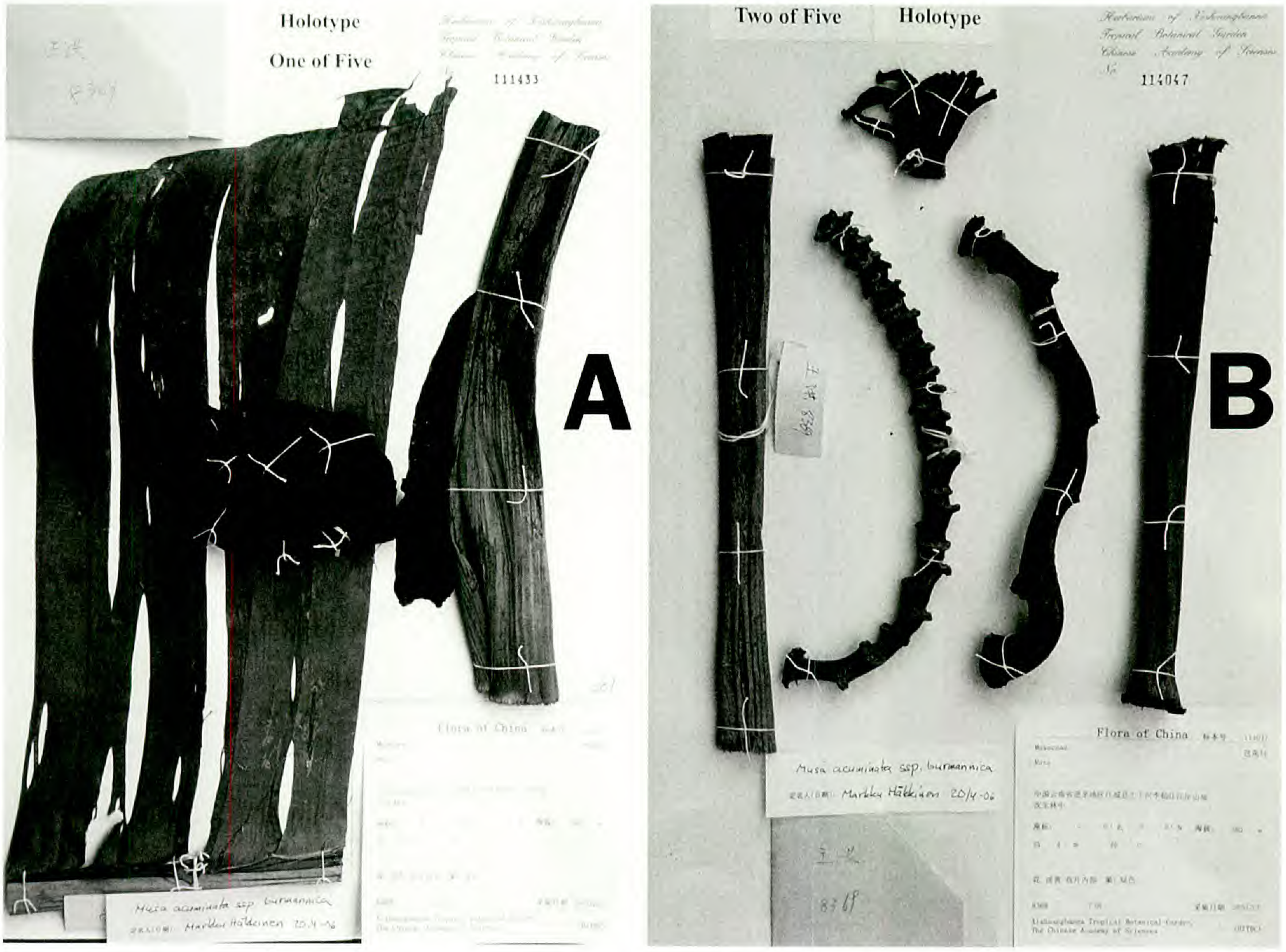

Figure 3. *Musa acuminata* var. *chinensis* Häkkinen & Wang Hong. —A–B. Holotype sheets one (A) and two (B) of five, *Wang Hong 8369* (HITBC).

Fruit bunch compact, with 5 hands and 17 fruits per hand on average, in 2 rows, fingers curved upward; individual fruit ca. 11 cm, curved, rounded, pedicel ca. 1.5 cm, glabrous, fruit apex with acumen ca. 0.5 cm and floral relicts, immature peel light green, becoming yellow at maturity, immature fruit pulp white, becoming creamy and soft at maturity; seeds nearly flat, wrinkled, ca. 4 mm diam., ca. 80 seeds per fruit. Chromosome numbers not counted.

Vernacular names. In Chinese, variety *chinensis* is called "Xiao Guo Ye Bajiao"—"Xiao" means small or little, "Guo" means fruit, "Bajiao" means banana. The Dai name "Boguimen" refers to "Bo" as tree, "Gui" means banana, and "men" means wild (Häkkinen, pers. obs.).

Distribution and habitat. *Musa acuminata* var. *chinensis* grows abundantly from the Lixian River on the China–Vietnam border to Xishuangbanna westward along the China–Laos border to the Yingjiang River (Häkkinen, pers. obs.). The new taxon then extends northward along the China–Burma border and is found in river watersheds along these slopes, at altitudes between 300 and 800 m. This species is also called the tree banana by the local people because it can grow under shaded tree cover. The new variety is not commonly cultivated for fodder.

Paratypes. CHINA. **Yunnan:** Mengla Co., Guangnali, Shorea forest, 1 Dec. 2005, *Wang Hong 8364* (HITBC); Xishuangbanna Trop. Bot. Garden, 2005, *He Li-qing 4, 25, 26, 45* (HITBC).

KEY TO *MUSA YUNNANENSIS* AND RELATED TAXA IN YUNNAN

1a. Sap watery; petiole margins curved inward; leaf bases auriculate; peduncle pubescent with short hairs; bracts red-purple externally, cream internally, with sharp yellowish apex, not imbricate . . . . . *Musa yunnanensis*

1b. Sap milky; petiole margins erect; leaf bases rounded; peduncle glabrous, bracts blue-purple externally, dark red internally, with obtuse cream apex, imbricate 2

2a. Upper parts of leaf-sheaths green-yellow, without any blotches, waxy; basal female flowers hermaphroditic . . . . . *Musa acuminata* var. *chinensis*

2b. Upper parts of leaf-sheaths bright green, with heavy reddish brown blotches, not waxy; basal flowers female 3

3a. Male flowers white with bright yellow apex; male bud persistent upon fruit maturity . . . . . *Musa acuminata* subsp. *burmannica*

3b. Male flowers pale orange-yellow with deep orange apex; male bud aborting before fruit maturity and dehiscense . . . . . *Musa flaviflora*

Figure 4. *Musa acuminata* var. *chinensis* Häkkinen & Wang Hong. —A. Fruit bunch. —B. Male flower. Photos by Häkkinen from the Xishuangbanna Tropical Botanical Garden, Yunnan, China.

In conclusion, both newly described taxa have huge potential breeding value. *Musa yunnanensis* is a cold-tolerant taxon and can stand several degrees of frost. It also appears to be disease resistant, as no common banana diseases have been observed among any visited wild populations. We observed more than 30 wild populations of *M. yunnanensis* during our field studies, with the individual plants varying from just a few up to hundreds, which were seen along roadsides, in river valleys and ravines, and on steep slopes. However, it remains to be determined how well the new species would thrive in altitudes below 500 m. Any natural variation within the species remains for further study. For breeding programs, *M. yunnanensis* is dwarf in size, and in some populations the fruit bunches are large and the flesh of the fruits is very sweet. The only challenge is to breed out the seeds.

Other similar germplasm from *Musa acuminata* subsp. *burmannicoides* De Langhe (1960) is already commonly used in breeding programs, so the two new, disease-free taxa could be worthy additions, especially in breeding new edible varieties: *M. yunnanensis* for cooler climates and *M. acuminata* var. *chinensis* for warmer ones. It is also notable that both *M. yunnanensis* and *M. acuminata* var. *chinensis* have basal, hermaphroditic female flowers and therefore self-pollination occurs before the floral bracts open.

Acknowledgments. This study was done in cooperation with the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, and the herbarium of Xishuangbanna Tropical Botanical Garden (HITBC). The authors greatly appreciate the help and support from the Xishuangbanna Tropical Botanical Garden staff. The authors also wish to thank Thierry Deroin, Natural History Museum, Paris, France, for the Latin diagnoses; Victoria C. Hollowell, scientific editor, for valuable suggestions; and Emory Walton from the California Rare Fruit Growers for proofreading this article.

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Studies in the Cleomaceae V: A New Genus and Ten New Combinations for the *Flora of North America*

Hugh H. Iltis and Theodore S. Cochrane

Department of Botany, University of Wisconsin, 430 Lincoln Drive, Madison, Wisconsin 53706, U.S.A. tscochra@wisc.edu

Abstract. New combinations are made for 10 taxa previously included in the genus *Cleome* L. s.l. These are now considered to belong in the genera *Cleoserrata* Iltis, which is newly described herein, *Hemiscola* Rafinesque, *Peritoma* DC., and *Tarenaya* Rafinesque, as follows: *Cleoserrata serrata* (Jacquin) Iltis, *C. speciosa* (Rafinesque) Iltis, *H. diffusa* (Banks ex DC.) Iltis, *P. arborea* (Nuttall) Iltis, *P. arborea* var. *angustata* (Parish) Iltis, *P. arborea* var. *globosa* (Coville) Iltis, *P. jonesii* (J. F. Macbride) Iltis, *P. multicaulis* (Moçiño & Sessé ex DC.) Iltis, *P. platycarpa* (Torrey) Iltis, and *T. hassleriana* (Chodat) Iltis. A lectotype is designated for the basionym of *Cleoserrata speciosa*, *Cleome speciosa* Rafinesque.

Key words: Cleomaceae, *Cleome*, *Cleoserrata*, *Hemiscola*, North America, *Peritoma*, *Tarenaya*.

The genus *Cleome* L. s.l. comprises over 200 species, mainly in warm, often dry regions of Latin America, Africa, and to a lesser extent, the Near East and Australia (Heywood et al., 2007). Although highly diverse in the Neotropics, approximately three dozen species are recognized in our unpublished comprehensive synopsis of New World Cleomaceae as occurring in North America north of Mexico. Meanwhile, a new generic description and several new combinations are needed immediately for the treatment of the Cleomaceae for the *Flora of North America*.

As will be brought out in the synopsis, Iltis' studies have shown *Cleome* to be an assemblage of distinct groups of species better recognized at generic rank. Thus, the generic concept of *Cleome* will be drastically emended, which in the narrow sense is an Old World group typified by *C. ornithopodioides* L. Three species still being treated as belonging to *Cleome* s. str., *C. viscosa* L., *C. rutidosperma* DC., and *C. ornithopodioides*, as well as *Gynandropsis gynandra* (L.) Briquet, do occur within the geographic range of the *Flora of North America*, but all are weedy introductions.

Cleoserrata Iltis, gen. nov. TYPE: *Cleome serrata* Jacquin [= *Cleoserrata serrata* (Jacquin) Iltis].

Herbae annuae, herbaceae, glaberrimae, inermes. Folia palmatim ternata vel quinata vel septenata, foliolis ciliato-serrulatis, bracteis minimis, subuliformibus vel nullis. Flores speciosi, petalis ab splendide roseis ad purpurea vel ab eburneis raro ad alba, sub anthesi subaequalibus et erectis, ad basin attenuatis vel brevi- vel longi-unguiculatis. Seminis fissura intus valde dilatata, invaginatione per membranam fissuralem conjunta, membrana interdum cellulis carunculariibus parvis inflatis oleosis obtecta.

Annual herbs, unarmed, sometimes fleshy-stemmed, glabrous, lacking spines. Leaves 3- or mostly 5- to 7-foliolate, leaflets minutely ciliate-serrulate; some species with minute, slender, hyaline stipules. Racemes bracteate to ± ebracteate (i.e., the bracts none or reduced to minute, caducous, linear-lanceolate, hyaline, 1-nerved structures), glabrous, if glandular then with upwardly reduced, progressively small, green bracts. Sepals 4, free or slightly united at base; corolla closed in bud; petals 4, free, subequal, variable in color, shape, and size, brilliant pink to purple, ivory or rarely white, attenuate to short- or long-clawed; receptacular disk obsolete or slightly expanded, to 3 mm; androgynophore produced by the adhesion of filament bases to the epidermis of the gynophore base, 1–16 mm long; stamens 6, the anthers elongate, longitudinally dehiscent. Capsules ellipsoid, fusiform or linear-cylindric, pendent, deflexed or erect, sessile or stipitate (gynophore); seeds many, the seed-cleft (in longitudinal section) narrow at mouth and greatly enlarged within, spherical, obovoid, or oblong, the invagination fused by a cleft-membrane covered in some species with a patch of small, inflated, oil-filled, caruncular cells (such cells lacking in *C. speciosa* and usually *C. serrata*).

As here construed, *Cleoserrata* includes glabrous annual herbs lacking spines or thorns and having a tendency to be ebracteate, having minutely serrulate leaf margins, and bearing showy pink to purple or ivory or white flowers, some with a definite androgynophore. It is segregated from *Cleome* partly on the basis of the unusual $x = 12$ chromosomal complement ($2n = 24$ [Pazy, pers. obs.; Przywara, pers. obs.], 48 [Pazy, pers. obs.; Przywara, pers. obs.]), and also from *Tarenaya* Rafinesque ($2n = 20$ and numbers derived

therefrom [Breedlove, pers. obs.; Crosswhite, pers. obs.; Kawano, pers. obs.; Kowal, pers. obs.; Pazy, pers. obs.; Przywara, pers. obs.; Ruíz Zapata et al., 1996]) on the basis of molecular evidence suggesting that it constitutes a more basal clade than does that genus (Inda, pers. comm.). *Cleoserrata* includes five species that range from Mexico and the West Indies to Bolivia (*Steinbach 5255*, G-DEL, GH, MVM, NY) and northern Argentina (*Jørgensen 3264*, GH, LIL, SI, US): *Cleome melanosperma* S. Watson, *Cleome paludosa* Willdenow ex Eichler, *Cleoserrata* sp. ined. from east-central Brazil, and the following two, which are relevant to the *Flora of North America*.

1. **Cleoserrata serrata** (Jacquin) Iltis, comb. nov. Basionym: *Cleome serrata* Jacquin, Enum. Syst. Pl. 26. 1760. *Neocleome serrata* (Jacquin) Small, Man. S.E. Fl. 577. 1933. TYPE: Colombia: Cartagena, *N. J. von Jacquin s.n.* (holotype, BM).

Cleoserrata serrata is a common weedy species native from northern South America (Colombia: *Killip & Smith 14903*, GH, NY, US) to Mexico (*Steere 1956*, F, MEXU, MICH) and the West Indies (Cuba: *Wright 1866*, BM, GH, MO), and rarely introduced in the southern United States, i.e., Georgia (Small, 1933; Duncan & Kartesz, 1981). This species is distinguished by minute, hyaline stipules, open, few-flowered racemes that appear ebracteate, and often white petals (varying to yellowish, greenish, or purplish).

2. **Cleoserrata speciosa** (Rafinesque) Iltis, comb. nov. Basionym: *Cleome speciosa* Rafinesque, Fl. Ludov. 86. 1817. *Cleome speciosa* Kunth, Nov. Gen. Sp. (HBK) 5: 84, t. 436. 1821, nom. illeg. *Gynandropsis speciosa* (Kunth) DC., Prodr. (DC.) 1: 238. 1824, nom. illeg. TYPE: t. 436, Kunth, in Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 5. 1821 (lectotype, designated here, t. 436, Kunth, 1821).

Cleoserrata speciosa is native to Mexico (*Hinton 4725*, BM, G, GH, MO, NY) but widely cultivated and occasionally escaped, e.g., throughout Central America (Guatemala: *Heyde & Lux 3937*, G, GH, M, MO, NY, US; Iltis, 2001) and the West Indies (Dominica: *Eggers 825*, G, L, M; Iltis, 2001), also northern South America (Colombia: *Klug 1660*, F, MO, NY), Louisiana (*Hale s.n.* [in 1880s], US) and Florida (*Tracy 7667*, CU, F, G, GH, ISC, MO, MSC, NEB, NY, US, WIS; Wunderlin, 1998), Africa (Kers, 1986), and the Orient (Ohashi, 1966).

It is fortuitous that both Rafinesque and Kunth should have chosen the same epithet, albeit an appropriate one, for this widespread, polymorphic species, which is characterized by the usual lack of pubescence, 1-foliolate bracts, and large flowers with pink to deep purple (rarely white), narrowly long-clawed petals to 4 cm long and usually greatly elongated androgynophores. Kunth's 1821 description covers all these points and more, whereas Rafinesque's, being brief, is inadequate to convey much of an impression of the species being portrayed. However, the phrase "foliolis...ciliatis" (Rafinesque, 1817: 86) definitely points to *Cleoserrata*, and the additional information given, including raceme size, flower size and color, country of origin (Mexico), and popularity in cultivation, leaves no doubt that he was referring to *C. speciosa*. Because it shows flowers and fruits in correct detail and agrees unambiguously with the protologue, Kunth's illustration is well suited to be the lectotype of *Cleome speciosa* Rafinesque.

Hemiscola Rafinesque

Rafinesque (1838) segregated *Hemiscola* from *Cleome* s.l. and included only the spiny *H. aculeata* (L.) Rafinesque and the unrelated and ambiguous name "*ornithopoides* Raf." (1838: 111) (sic, *C. ornithopodioides* L.). Adopting a broader view of the genus, Iltis reckons that it encompasses fewer than 10 spiny species (and the rare unarmed forms) characterized by white to cream flowers in short, bracteate inflorescences or solitary in the axils of leaves and by horseshoe-shaped seeds that have the mouth of the cleft covered by a thin membrane, the tip of the radicular claw expanded into a large, white or ivory, funicular aril, and the testa transverse-wrinkled or irregularly tubercled, the ridges or excrescences sparsely pubescent on their crests with minute clusters of caducous white hairs. The chromosome number is $2n = 18$ (Crosswhite, pers. obs.; Pazy, pers. obs.), derived by aneuploid reduction from $2n = 20$ for *Tarenaya* (see under *Cleoserrata* above). The spininess suggests a relationship to *Tarenaya*, as do molecular data (Hall et al., 2002). This genus is entirely South American except for the widespread, weedy *H. aculeata*, which barely encroaches into the southern United States, i.e., southern Texas (*Runyon 145*, TEX) and Alabama (Mohr, 1901). A second species, the Brazilian *H. diffusa* (Banks ex DC.) Iltis, has been locally introduced into Alabama and is herein transferred to *Hemiscola*.

1. **Hemiscola diffusa** (Banks ex DC.) Iltis, comb. nov. Basionym: *Cleome diffusa* Banks ex DC., Prodr. (DC.) 1: 241. 1824. *Cleome aculeata* L. var. *diffusa* (Banks ex DC.) Kuntze, Revis. Gen. Pl. 3, pt. 2: 7. 1898. TYPE: Brazil. Rio de Janeiro: *J. Banks & D. C. Solander s.n.* (holotype, BM).

Additional specimen examined. U.S.A. **Alabama:** ballast grounds, Hunters Wharf, Mobile, 1893, *Mohr s.n.* (NY, US).

PERITOMA DC.

Peritoma was erected by DC. (1824) for a single, common, showy, and variable species, *P. serrulata* (Pursh) DC. (as *P. serrulatum*). Although *Peritoma* has been recognized from time to time in the past, most workers have preferred to keep *P. serrulata* in *Cleome* (e.g., Vanderpool, 1993; Holmgren & Cronquist, 2005). Iltis resurrects this generic name for de Candolle's species to include five others, clearly related, which share with it the following suite of characters: plants mostly annual, glabrous (pubescent only in *P. platycarpa* (Torrey) Iltis), and unarmed; leaflets 1–6 cm long, entire; flowers yellow or pink to purple or white, borne in the axils of leafy, 1- to 3-foliolate bracts; petals sessile or subsessile, more or less radially arranged in the open flower; anthers coiled when dry; and seed-cleft covered nearly the whole length by the testa or by a hard membrane, the cleft-cavity very long and narrow or obsolete. The chromosome numbers of *Peritoma* are $2n = 32$ (Rollins, 1939; Ward & Spellenberg, 1988), 34 (Raven et al., 1965; Mulligan, 1966), 40 (Tiehm & Day, 1987), or rarely 60 (Mulligan, 1965), showing frequent reduction by aneuploidy (to $2n = 32$ or 34) and suggesting tetraploidy from the ancient base number of $x = 10$. The genus is distributed primarily in deserts, semideserts, and grasslands across the northern half of Mexico and the western United States (Iltis, 1957) but reaches as far east as the Dakotas (Great Plains Flora Association, 1977) (and rarely beyond) and as far north as southern Canada (Scoggan, 1978). All six species, one comprising three varieties, occur in this region, necessitating the following new combinations.

1. Peritoma arborea (Nuttall ex Torrey & A. Gray) Iltis, comb. nov. Basionym: *Isomeris arborea* Nuttall, Fl. N. Amer. (Torrey & A. Gray) 1: 124. 1838. *Cleome isomeris* Greene, Pittonia 1(14): 200. 1888, replacement name for *Isomeris arborea* Nuttall, Fl. N. Amer. (Torrey & A. Gray) 1: 124. 1838, non *Cleome arborea* Kunth, Nov. Gen. Sp. (HBK) 5: 86. 1821. TYPE: U.S.A. California: St. Diego, s.d., *T. Nuttall s.n.* (holotype, BM, BM photo at WIS).

1a. Peritoma arborea (Nuttall ex Torrey & A. Gray) Iltis var. **arborea**.

1b. Peritoma arborea var. **angustata** (Parish) Iltis, comb. nov. Basionym: *Isomeris arborea* var. *angustata* Parish, Muhlenbergia 3: 128. 1907. TYPE: U.S.A. California: western edge of Colorado Desert, Palm Sprs., *S. B. Parish s.n.* (holotype, GH).

1c. Peritoma arborea var. **globosa** (Coville) Iltis, comb. nov. Basionym: *Isomeris arborea* var. *globosa* Coville, Proc. Biol. Soc. Wash. 7: 73. 1892. TYPE: U.S.A. California: Kern Co., Caliente Creek, a few mi. above Caliente, 24 June 1891, *F. V. Coville & F. Funston 1107* (holotype, US; isotype, US).

2. Peritoma jonesii (J. F. Macbride) Iltis, comb. nov. Basionym: *Cleome lutea* Hooker var. *jonesii* J. F. Macbride, Contr. Gray Herb. 65: 39. 1922. *Cleome jonesii* (J. F. Macbride) Tidestrøm, Proc. Biol. Soc. Wash. 48: 39. 1935. TYPE: U.S.A. Arizona: Verde Valley, 24 July 1920, *W. W. Jones 168* (holotype, GH).

3. Peritoma lutea (Hooker) Rafinesque.

4. Peritoma multicaulis (Moçiño & Sessé ex DC.) Iltis, comb. nov. Basionym: *Cleome multicaulis* Moçiño & Sessé ex DC., Prodr. (DC.) 1: 240. 1824. TYPE: Mexico. "Fl. mex. Ic.," Sessé & Moçiño Illustr. Hunt Inst. 6331.0918 (lectotype, designated by McVaugh, 2000: 117).

Cleome sonorae A. Gray, Pl. Wright. 2: 16. 1853. *Peritoma sonorae* (A. Gray) Rydberg, Bull. Torrey Bot. Club 33: 142. 1906. Syn. nov. TYPE: Mexico. Sonora: W of Chiricahui Mtns., 6 Sep. 1851, *C. Wright s.n.* (holotype, GH; isotypes, CGE, GH, MO).

5. Peritoma platycarpa (Torrey) Iltis, comb. nov. Basionym: *Cleome platycarpa* Torrey, U.S. Expl. Exped., Phan. 17(2): 235, t. 2. 1874, non *Cleome platycarpa* Schinz, Verh. Bot. Vereins Prov. Brandenburg 29: 50. 1888. *Celome platycarpa* (Torrey) Greene, Pittonia 4: 211. 1900. TYPE: U.S.A. California: northern California, Klamet River [sic], Oct. 1841, *W. D. Brackenridge & W. Rich* [*Wilkes Exped.*] *1579* (lectotype, designated by Holmgren & Cronquist, 2005: 166, NY; isotype, US).

6. Peritoma serrulata (Pursh) DC.

TARENAYA

The majority of New World species classified in the genus *Cleome* comprise a very large and diverse group for which the name *Tarenaya* (Rafinesque, 1838: 111) is available. Extreme variation occurs in plant size and pubescence, flower color, and seed coat texture, but the typical presence of spines and bracts and characters of the disk and seeds unite these species.

The disks are obsolete or disciform or, if conic, nearly always only slightly developed. The cleft of the mature seed is covered for most of its length by a thin, fragile, slightly shrunken membrane, and the cleft cavity between the two claws is spherical, obovoid, or oblong. The petals are usually unilateral and erect in the open flower and narrowly clawed. The chromosome numbers of *Tarenaya* are $2n = 20$ or 40 (Przywara, pers. obs.) or the specialized number 30 (Przywara, pers. obs.), apparently derived by chromosome fusion in one subgroup (Przywara, pers. obs.). *Tarenaya* is best represented in tropical lowlands and arid plateaus at medium elevations in northern and eastern South America (Eichler, 1865; Ruíz Zapata & Iltis, 1998) but ranges north to southern Mexico (Iltis, 1998) and the West Indies (Iltis, 1958, 2001). Although recognizing that some two dozen species presently assigned to *Cleome* have yet to be transferred to *Tarenaya* for the first time, only one such transfer is proposed here to ensure the name will be available for the upcoming volume 7 of the *Flora of North America*.

1. Tarenaya hassleriana (Chodat) Iltis, comb. nov.
Basionym: *Cleome hassleriana* Chodat, Bull. Herb. Boissier 6, App. 1: 12. 1898. TYPE: Paraguay. "Ad ripam fluminis pr. Apa, fl. Maj.," *E. Hassler 162* (holotype, G-BOIS).

This is the common cultivar known as the spiny cleome (*Cleome spinosa*), but *Cleome spinosa* Jacquin is a different species Iltis treats as *Tarenaya spinosa* (Jacquin) Rafinesque. The latter is easily distinguished by the presence of minute glandular puberulence on the tips of the petals in bud and on the youngest capsules and white petals except for occasional intermediates between *T. spinosa* and *T. hassleriana* from the West Indies and Venezuela (Iltis, 1952), in which they are pinkish or purplish. In *T. hassleriana* the tips of the petals and capsules are glabrous, and the petals are pale to deep pink or purple or rarely white in horticultural varieties.

Native from northern Argentina (*Burkart 8302*, F, G) to Minas Gerais, Brazil (*Widgren 786*, BR, C, K, LE, M, PH, U), *Tarenaya hassleriana* occasionally escapes elsewhere, particularly throughout the eastern United States (Maryland: *Tidestrøm 14455*, WIS) but also in Hawaii (Wagner et al., 1999), the West Indies (Adams, 1972), Asia (Bangladesh: *Hassan 365*, WIS), Africa (Engler, 1915; Kers, 1969; Jordaan, 2003), and Australia (Harden, 1990).

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Studies in the Capparaceae XXXII: A New Combination in *Quadrella*

Hugh H. Iltis

Department of Botany, University of Wisconsin, 430 Lincoln Drive, Madison, Wisconsin 53706, U.S.A. tscochra@facstaff.wisc.edu, wisc@charter.net

Xavier Cornejo

The New York Botanical Garden, 200th St. and Kazimiroff Ave., Bronx, New York 10458-5126, U.S.A. xcornejo@nybg.org, xcornejoguay@gmail.com

Abstract. *Quadrella incana* (Kunth) Iltis & Cornejo is transferred from *Capparis* L. to *Quadrella* (DC.) J. Presl, and the name is lectotypified. The taxon occurs from southeastern Texas, south to Mexico, Guatemala, and northern Honduras.

Resumen. *Quadrella incana* (Kunth) Iltis & Cornejo es transferida desde *Capparis* L. a *Quadrella* (DC.) J. Presl, y su lectotipo es aquí designado. Esta especie se encuentra distribuida desde el sudeste de Texas y hacia el sur, a través de México y Guatemala hasta el norte de Honduras.

Key words: Capparaceae, Mesoamerica, North America, *Quadrella*.

Quadrella (DC.) J. Presl (Capparaceae) is an American genus characterized by the combination of peltate to stellate, candelabroid or dendroid trichomes; valvate calyx; and dehiscent siliques or silicles bearing seeds with green, white, or cream embryos. The genus is distributed from southern North America (Texas and Florida) through Central America south to Panama, northern Colombia, and Venezuela and in the West Indies.

For the forthcoming treatment of the Capparaceae for the *Flora of North America*, *Quadrella incana* (Kunth) Iltis & Cornejo is transferred from *Capparis* L. on account of its stellate pubescence and silicles bearing cream- to ivory-embryoned seeds.

Quadrella incana (Kunth) Iltis & Cornejo, comb. nov. Basionym: *Capparis incana* Kunth, Nov. Gen. Sp. 5: 94. 1821. *Octanema incana* (Kunth) Rafinesque, Sylva Tellur. 108. 1838. TYPE: Mexico. Guerrero: "Crescit in declivitate occidentali montium Mexicanorum, inter Mescala et Estola, alt. 300 hex., Floret Aprili." *A. Humboldt & A. Bonpland s.n.* (lectotype, designated here, P; isotype, B-W 10,045, B-W photo 9479 at WIS).

Capparis karwinskiana Schlechtendal, Linnaea 10: 237. 1836. Syn nov. TYPE: Mexico. San Bartolo, 1830, *W. F. Karwinski s.n.* (holotype, M; isotype, BR, BR photo at WIS).

Shrubs or trees to 10 m tall, 60 cm DBH, stellate-tomentulose throughout, rusty brownish on young, conduplicate leaves and buds, pale gray to whitish with age. Leaves alternate, with blades lanceolate or narrowly elliptic to oblanceolate or obovate to rhombic, 2–7(–9) × 0.6–3.5(–4.2) cm, acute at the apex, cuneate to obtuse at the base, densely stellate, soon glabrescent adaxially, whitish or grayish and tomentulose to tomentose-stellate abaxially, with (3 to)4 to 8(to 9) pairs of lateral veins, these frequently arcuate ascendent at least at base and sometimes reddish; petioles 5–22 mm. Inflorescences axillary, on short, densely whitish stellate peduncles 0.4–2.5(–3) cm, each bearing a subumbellate or corymbose raceme of 3 to 7 small flowers, each subtended by a linear, 1–2 mm, densely stellate, caducous floral bract; pedicels 4–12 mm. Sepals usually linear to filiform, sometimes narrowly oblong to lanceolate, 2–5 × 0.5–0.9 mm, often downward contorted when dry, densely stellate without and within, each subtending a 1 mm, densely canescent triangular gland that persists in fruit; petals elliptic to oblong, 4–8 × 2.5–4 mm, white, tomentose-stellate without, apparently glabrous within; stamens 8, filaments 6–9 mm, stellate on basal half, sometimes to entire length, inserted on 1 mm, glabrous androgynophore; anthers 1.5–2.5 mm, yellow; gynophore 3–7 mm; ovary ca. 2 mm, ellipsoid, ± longitudinally ribbed at anthesis, both densely whitish stellate. Fruits globose or ovoid to oblongoid or ellipsoid silicles, 8–17 × 7–9 mm, green, reddish green, cream or gray, densely tomentose-stellate without, red within, short-stipitate on 3–8 mm gynophores, 3–9(–15) mm pedicels, and 0.4–2.5(–3) cm peduncles, at maturity dehiscent, with the fruit coat splitting open along 2 to 4 repla strands into 2 to 4 recurved, thin valves that clearly separate from the tip and sharply recurve up

and over the fruit to expose a compact, bright red, coalescent aril/pulp/seed package suspended underneath; seeds (1 to)2 to 6 per fruit, 4.5–6 × 4–5 mm, with the light brown testa firm, hard and brittle, ± deeply invaginated to form a cleft separating the radicular from the cotyledonar claw embryo, cream to ivory, cochleate reniform, cleomoid, the thin cotyledons variously multi-folded.

The type of *Capparis incana* was not mentioned in the original publication. Due to this reason, the selected collection has been designated lectotype.

Distribution and habitat. In dry woodlands, from southwestern to eastern Mexico, where very common, rarely into southeastern Texas, east to Guatemala and into northern Honduras.

Selected specimens examined. GUATEMALA. **Baja Verapaz:** Unión Barrios, *E. Contreras 11084* (DUKE, LL-TEX, US). **El Progreso:** Finca La Pita, Marajuma, *J. Castillo 1624* (F). **Petén:** Dos Lagunas, *E. Contreras 8596* (LL-TEX). HONDURAS. **Comayagua:** betw. Comayagua & Palmerola, *A. Molina & A. Molina 26028* (BM, DUKE, F, MO, NY, US). MEXICO. **Campeche:** Mun. Champotón, Conhuas Viejo, *P. Zamora & J. Hernández 4420* (MEXU). **Chiapas:** Mun. La Trinitaria, 15 km E de El Limón, *E. Martínez & A. Reyes 20248* (MEXU). **Colima:** Base of Cerro de San Gabriel, *H. H. Iltis, R. Koeppen & F. Iltis 635* (K, MEXU, MICH, MO, RSA, SP, US, WIS [2, wood sample at MAD 21962]). **Guerrero:** Acapulco, *E. Palmer 576* (F, GH, K, MO, NY, UC, US). **Jalisco:** Mun. La Huerta, Costa Careyes, *M. Guadalupe 91-45* (BRIT). **Nuevo León:** ca. 36 mi. SE Montemorelos along Mex. Hwy. 85, *J. Dwyer et al. 19* (MO, WIS). **Oaxaca:** Near Xandani, *R. King 1557* (MICH, NY, TEX, UC, US). **Puebla:** Near Coxcatlán, *C. Smith, F. Peterson & N. Tejeda 3625* (F, GH, MEXU, NY, US). **Querétaro:** Mun. Arroyo Seco, *E. Carranza 2515* (MA). **Quintana Roo:** Punta Sam, *H. Quero & R. Grether 2983* (MEXU, MO, WIS). **Tamaulipas:** Vic. Victoria, *E. Palmer 89* (CAS, F, GH, K, MO, NY, UC, US). **Veracruz:** Mun. Pánuco, 7 km SE of Ebano, *M. Nee & K. Taylor 25797* (F, WIS, XAL). **Yucatán:** Progreso, *C. Lundell & A. Lundell 8115* (BRIT, DS, DUKE, F, GH, LL-TEX, MEXU, MICH, NY, SMU, US, WASH). U.S.A. **Texas:** Hidalgo Co., Santa Ana Natl. Wildlife Refuge, *D. Correl & H. Correl 38870* (BRIT, WIS).

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Two New Species and a Reassessment of Synonymy in the *Navarretia pubescens* Complex (Polemoniaceae) of Western North America

Leigh A. Johnson

Department of Biology and the S. L. Welsh Herbarium, 401 WIDB, Brigham Young University, Provo, Utah 84602, U.S.A. leigh_johnson@byu.edu

Abstract. Two new species in the *Navarretia pubescens* (Bentham) Hooker & Arnott complex of section *Mitracarpium* Brand are described: *N. gowenii* L. A. Johnson and *N. ojaiensis* Elvin, J. M. Porter & L. A. Johnson. *Navarretia gowenii* is known from disjunct locations in Contra Costa and Stanislaus counties of California. *Navarretia ojaiensis* is known from Ventura County, California. Additionally, examination of type specimens suggests *N. mitracarpa* Greene, presently placed in synonymy under *N. pubescens*, be recognized as a species distinct from the latter taxon, whereas *N. jaredii* Eastwood be recognized as a synonym of *N. mitracarpa*.

Key words: IUCN Red List, *Navarretia*, Polemoniaceae.

Navarretia Ruiz & Pavón sect. *Mitracarpium* Brand circumscribes ca. eight species that are distinguished from other *Navarretia* by their externally pubescent corollas, calyx ribs that are wider at the base than the intercostal membrane, and fruits that dehisce upward from the base. Section *Mitracarpium* is further divided into two informal species complexes: those with axes of upper leaves and often bracts expanding above the middle into a somewhat ovate rachis, and those with upper leaves and bracts that retain a narrow, linear rachis throughout the length of the organ. This feature is used as a key character by Day (1993), with only *N. pubescens* (Bentham) Hooker & Arnott, typically with an expanded terminal leaf segment, occasionally found with only a linear upper rachis. Nuclear ribosomal ITS sequences (Spencer & Porter, 1997) indicate these two groups are reciprocally monophyletic. Following Day (1993), this broad-axis group, hereafter referred to as the *N. pubescens* complex, comprises three species: *N. pubescens*, *N. jaredii* Eastwood, and *N. setiloba* Coville. A fourth species, *N. mitracarpa* Greene, which is encountered in floras prior to Day's (1993) treatment and on many herbarium sheets, was synonymized by Day under *N. pubescens*. Other names currently synonymized under the above taxa have never been widely accepted.

Recent field and herbarium work has brought to light two new species that clearly belong in *Navarretia* sect. *Mitracarpium*. Expanded axes of the upper leaves and often bracts, deeply lobed cotyledons, and DNA sequences from the nuclear ITS and noncoding chloroplast regions (Johnson, unpublished) further ally these putative species with the *N. pubescens* complex. Here, a key to the *N. pubescens* complex is presented that reflects the nomenclatural changes proposed herein. Two new species, *N. gowenii* L. A. Johnson and *N. ojaiensis* Elvin, J. M. Porter & L. A. Johnson, are proposed. Synonymy of names within the *N. pubescens* group is re-evaluated against type material, with adjustments to current synonymy suggested. All work was completed under the framework of the unified species concept (de Queiroz, 2005) using consistent character differences as an operational method for species delimitation (Snow et al., 2003; Sites & Marshall, 2004).

Key to Species of the *Navarretia pubescens* Complex

1a. Plants ± taller than broad with a dominant, erect central axis; secondary branches shorter than, and typically not exceeding, the primary axis in absolute length or the terminal inflorescence of the primary stem in overall height 2

2a. Inner bract axis usually expanded below and above the middle; upper stem, bracts, and calyces minutely puberulent, with elongate trichomes, if present, restricted to a narrow band around the midsection of the calyx or the upper portion of the bract base. . . . . *N. setiloba*

2b. Inner bract axis usually expanded only below the middle; upper stem, bracts, and calyces puberulent to short-glandular, with elongate trichomes common and conspicuous on bracts and calyces 3

3a. Corolla lobes, throat, and tube blue-purple; anthers exserted to corolla tips or beyond; stigma exserted . . . . *N. pubescens*

3b. Corolla lobes and tube white to cream with a purple spot at the anastomoses of the corolla veins (veins below the anastomoses also drying purple); anthers included to exserted below middle of corolla lobe; stigma included. . . . *N. gowenii*

1b. Plants ± as broad as tall, branching from near the base, secondary branches often equaling or exceeding the primary axis in absolute length and the terminal inflorescence of the primary stem in overall height 4

4a. Upper stems and inflorescence heads often densely white villous (but sometimes glandular); corolla lobes rounded to acute, blue to violet with darker spots at point of corolla vein anastomoses; throat and tube white. . . . . *N. mitracarpa*

4b. Upper stems and inflorescence heads glandular; corolla lobes apiculate, white, purple spotted at point of corolla anastomoses; throat and tube white to cream . . . . . *N. ojaiensis*

1. Navarretia gowenii L. A. Johnson, sp. nov. TYPE: U.S.A. California: Contra Costa Co., Lime Ridge Open Space on N side, ca. 600 ft., just SE of one of the quarries, clay soil, 25 May 2005, *D. Gowen 390* (holotype, JEPS; isotypes, BRY, MO, RSA). Figure 1.

Species nova ab *Navarretia pubescenti* (Bentham) Hooker & Arnott lobis, fauce et tubo corollae albis (non caesio-purpuratis); staminibus vix ad vel infra medium loborum corollae attingentibus (non ad vel supra apices corollae); stigmate incluso (non exserto) differt.

Taprooted annuals, typically erect with primary axis dominating any secondary axes; primary axis to 30 cm tall; secondary axes 0.1 to 5 cm. Lowermost leaves opposite, pinnate to bipinnate with a filiform rachis and lobes, becoming alternate but congested in a loose rosette, withering with age; internodes expanding above, with associated leaves ca. 3–4 cm long, odd bipinnate with ca. 5 opposite to subopposite lobes to 6 mm, the lowermost arising immediately from the base and ± palmately lobed; subsequent lobes pinnately divided with secondary lobes often arising at ± right angles to the primary rachis; the terminal lobe with a somewhat widening rachis and short, acerose secondary lobes or teeth; upper leaves, typically subtending axillary branches, to 3 cm long, similar to lower leaves except persistent and the terminal lobe with a broad rachis to 2 mm wide and bearing ca. 8 lobes (1 or 2 may be forked) along each edge. Flowering heads terminating primary and secondary stems, ca. 10(–15) mm diam. exclusive of projecting bract tips, to 25 mm inclusive of bract tips; outer inflorescence bracts 10–15 mm, pinnate, with a somewhat expanded base and expanded terminal, toothed, segment; the lowermost lobes increasing in length toward middle of bract and V- or Y-shaped with forks perpendicular to the bract axis. Inner bracts exceeding calyces with an expanded chartaceous base, palmately lobed below and pinnate above along the primary rachis; bracts immediately subtending flowers ± equal to calyces in length; pubescence along stems ca. 0.1–0.15 mm in length, increasing to 0.5 or 0.6 mm in the inflorescence; flowering heads with ca. 8 to 24 flowers in subsessile cymose pairs; calyx 6–7 mm, lobes unequal, entire, or the longest toothed, lobes green and acerose adaxially, chartaceous and linear abaxially, connecting at the base; intercostal membrane V-shaped, narrower at the base than the lobes, forming a tube ca. 3–4 mm; calyx glandular externally to base, internally only on free portion of the lobes, the glands short-stipitate near calyx base and becoming longer near mouth of calyx tube; corolla 8–10 mm, exceeding calyx, lobes 1.2–2 mm; lobes, throat, and tube white (drying cream) with purple dots at base of corolla lobes and purple streaking (along vasculature) in throat; stipitate-glandular externally, glabrous internally; stamens attached ± equally ca. 2.5 mm below the sinus, filaments unequal to subequal in length, 2–3 mm, included to exserted less than 1/3 length of corolla lobes; anthers ca. 0.9 mm, pollen white, spheroidal, pantoporate with sexine semitectate, reticulate, and heterobrochate; ovary situated on a nectary disk; style ± 5–6 mm, included in corolla throat, stigma bilobed, each lobe ca. 0.4 mm. Capsules ca. 3.8 mm, with an apicular beak (ca. 0.15 mm) subtended by anthocyanic spot, not exceeding calyx prior to dehiscence; chartaceous in upper 2/3 and membranous in lower 1/3, dehiscing unevenly but circumscissile at this junction with 4 valves splitting incompletely toward apex; seeds 1 or 2 per fruit, ca. 2.5 mm, brown, producing spiricles when wetted; embryos with 2 or 3 cotyledons, each divided to near the base into 2 lobes.

Distribution and IUCN Red List category. *Navarretia gowenii* is known from three sites no more than 1 km apart in the Lime Ridge Open Space in Contra Costa County, California, and a third population represented by a single collection 110 km southeast made on serpentine soils on private land in Stanislaus County. This latter material has slightly longer stamens, with anthers extending beyond the orifice rather than included. Since their first discovery in 2003, the populations at Lime Ridge have fluctuated in response to moisture availability, with estimates of several hundred individuals per population in wet years to fewer than 50 individuals in dry years. The Quinto Canyon population has not been revisited since its collection as part of a routine plant survey of the area. A preliminary conservation assessment places this taxon in Red List Category DD (Data Deficient; IUCN, 2001) because long-term trends are unknown; however, what is known about its distribution and population size suggests the plant is vulnerable and further study is warranted.

Etymology. This species is named after David Gowen, an avid naturalist, plant enthusiast, and volunteer at the Jepson Herbarium. Mr. Gowen recognized the essential differences distinguishing this species from other *Navarretia* and brought them to the author's attention. He has since made substantial

Figure 1. *Navarretia gowenii* L. A. Johnson. —A. Photograph of unmounted specimens from the type collection (*Gowen 390*). —B. (inset) Illustration of opened corolla with style, following post-pollination dehiscence and showing relative position of stamens and vasculature in corolla lobes and base (*Gowen 102*, BRY).

contributions to this author's study of *Navarretia*. Mr. Gowen's consideration of detail, love of nature and fieldwork, and persistence are admirable traits worth emulation by all students of botany.

Discussion. The included style and included to barely exserted stamens set *Navarretia gowenii* apart from all other members of the *N. pubescens* group. Though it shares similar corolla coloration with *N.*

ojaiensis, it differs from this species in a number of characters detailed in the discussion of this latter taxon.

Paratypes. U.S.A. **California:** Contra Costa Co., Lime Ridge Open Space, NW end, ca. 600 ft., 13 June 2004, *D. Gowen 102* (BRY, JEPS); Lime Ridge Open Space, summit area just S of antenna facility, 11 May 2004, *D. Gowen 59* (JEPS); Stanislaus Co., Quinto Canyon at Bald Eagle Mine, T8S R7E SE1/4 of SW1/4 S32, canyon bottom setting on serpentine, 26 May 1995, *D. W. Taylor 14923* (JEPS [2]).

2. Navarretia mitracarpa Greene, Pittonia 1: 135. 1887. *Gilia mitracarpa* (Greene) Rattan, West Coast Botany 53. 1898. TYPE: U.S.A. California: Lake Co., June 1884, *K. Curran s.n.* (holotype, NDG digital image seen; isotypes, CAS, GH not seen, NY digital image seen, UC, US).

Navarretia jaredii Eastwood, Zoe 5: 89–90. 1900. *Gilia jaredii* (Eastwood) K. Schumann, Just's Bot. Jahresber. 28: 489. 1902. *Navarretia mitracarpa* Greene subsp. *jaredii* (Eastwood) H. Mason, Ill. Fl. Pacific States 3: 448. 1951. TYPE: U.S.A. California: San Luis Obispo Co., Paso Robles Creek, May 1897, *L. Jared s.n.* (holotype, CAS).

Navarretia mitracarpa Greene var. *villosa* Hoover, Vasc. Pl. San Luis Obispo Co., Calif. 229. 1970. TYPE: U.S.A. California: San Luis Obispo Co., betw. Rocky Butte & Pine Mtn., Santa Lucia Range, 21 June 1950, *R. Hoover 8006* (holotype, OBI).

Navarretia mitracarpa was generally accepted as a distinct taxon in floristic treatments prior to Day (1993). Day considered *N. mitracarpa* conspecific with *N. pubescens*, but did not elaborate her rationale, a position apparently also accepted by Spencer (Spencer & Porter, 1997) based on his annotation of the isotype specimen at US. Type material of *N. mitracarpa* differs from *N. pubescens* in its spreading rather than upright habit, and, as evident on the material at US, the corolla throat is white rather than bluish purple. Brand (1907) recorded four deeply divided cotyledons in this species; this is likely a typographical error, and instead he meant two deeply divided cotyledons that appear as four linear segments. Jepson (1943) records (from V. L. Bailey's dissection of the UC isotype) "...cotyledons as if 6, each of the two cotyledons deeply parted into 3 lobes" and S. C. Spencer, in the fragment pack on the isotype specimen at US, records just four segments (with the embryo still available for observation). My own survey from multiple populations and multiple stages of development of taxa in this complex shows that the number of cotyledons can vary from two to three within a single population of *N. gowenii*, *N. pubescens*, and *N. mitracarpa*, and that individual cotyledons are invariably deeply 2-lobed so as to appear as if cotyledons are four or six in number (*N. setiloba* and *N. ojaiensis* showed only three cotyledons, but only two seeds from a single population each were available for study). Such variation within populations diminishes the taxonomic value of cotyledon number for distinguishing among taxa in this group.

The placement of *Navarretia mitracarpa* under synonymy of *N. pubescens* at first seems plausible because the type locality of *N. mitracarpa* is listed as Lake County, California, and the only other presently known member of the *N. pubescens* group in Lake County is *N. pubescens*. However, Jepson (1943) noted that K. Curran's collecting habits were disorderly; although she may have been in Lake County in June 1884, this does not exclude the possibility of other collections elsewhere that month, or that the date itself is correct. Indeed, the holotype records the date as August 1884, the specimen at UC lists June, and the specimens at NY and US have no date at all, but are labeled "part of the type." The fact that Curran (Brandegee, 1893) herself considered *N. mitracarpa* to be conspecific with *N. filicaulis* (Torrey ex A. Gray) Greene (as *Gilia filicaulis* Torrey ex A. Gray) suggests that she considered it distinct from *N. pubescens* even if she was not correct in her assessment of its affinities. In deference to the characters observable on the types, this author considers *N. mitracarpa* distinct from *N. pubescens*, but indistinct from *N. jaredii*.

Material presently identifiable to *Navarretia jaredii*, following Day (1993), is here referred back to *N. mitracarpa*. Mason (1951), who treated *N. jaredii* as a subspecies of *N. mitracarpa*, indicated the former has a larger flowering head than the latter. However, as noted by Hoover (1970), the type sheet for *N. jaredii* has four specimens on it, and the original description describes the upper two, smaller-headed plants, not the lower two, larger-headed individuals. The small-headed individuals are consistent in characteristics, insofar as development can ascertain, with both the types and original descriptions of *N. mitracarpa*. Hoover (1970: 229) suggested the lower two plants, which are developmentally immature and lacking flowers, may be *N. pubescens*; whether this is the case or they simply represent ecological plasticity cannot be presently determined. This author follows Hoover in placing *N. jaredii* as a synonym of *N. mitracarpa*. Hoover (1970: 229) further distinguished a typical variety *mitracarpa* and a more densely pubescent form, *N. mitracarpa* var. *villosa*. There is noticeable variation in pubescence among collections of this species, but the geographic integrity of such variation and its correlation with other observable features has yet to be fully ascertained. The spreading habit of *N. mitracarpa* may be ecologically plastic: the larger-headed individuals from the type sheet for *N. jaredii* are upright rather

than spreading in habit, and similar upright forms with larger heads that are clearly allied with *N. mitracarpa* rather than *N. pubescens* in floral features have been collected in tall grass by this author. These are not distinguishable from typical *N. mitracarpa* by a suite of rapidly evolving, noncoding chloroplast regions (Johnson, unpublished).

3. Navarretia ojaiensis Elvin, J. M. Porter & L. A. Johnson, sp. nov. TYPE: U.S.A. California: Ventura Co., Ventura River Basin, meadow betw. Calif. Prep. School & Ojai, 15 June 1948, *H. M. Pollard s.n.* (holotype, UC1008707; isotypes, RSA43448, SBBG98249). Figure 2.

Species nova ab *Navarretia mitracarpa* Greene lobis corollae albis (non azureis), acuminato-cuspidatis (non rotundatis) differt.

Taprooted annuals; low and spreading to more often erect, primary axis 4.2–32.5 cm tall; stems hirsute to glandular-pilose, 0.9–2 mm diam., tawny yellow, pale green suffused with purple, to strongly anthocyanic; frequently branching from the base, the lowest branches 4.4–18.2 cm. Leaves 12–32 mm, bipinnately dissected, bright green, glandular-pilose; lateral lobes 3.5–7.5 mm, narrow and often acerose; terminal lobe 12–18 × 1.5–4 mm, narrowly rhombic to narrowly obtrullate, dentate-aculeate, the teeth to 3 mm; leaves only slightly reduced in size on distal stems. Inflorescences glandular-pilose, terminating primary and secondary (and occasionally third order) branches, capitate, bracteose, bracts pungent; flowers in cymose dichasia; head 8–32 mm diam.; inflorescence bracts like the upper cauline leaves, 10–17 mm, bipinnately dissected, glandular-pilose; lateral lobes 1–4.5 mm, usually acerose; terminal lobe 7–13 × 0.5–2 mm, linear to narrowly rhombic, dentate-aculeate. Floral bracts 6–10 mm, pinnately dissected, glandular-pilose; with (1)2 to 3 lateral lobes, lobes narrow, acute to acerose; terminal lobe 2.5–3.5 mm, linear, acerose; calyx campanulate to tubular, 6.5–9.6 mm, glandular-pilose; lobes unequal in length and usually polymorphic, 3–6.5 mm, linear and entire to pinnatifid with 3 to 5 acute to acerose lobes; calyx tube short, 2–3.3 mm; the green costae of lobes much broader than hyaline portion of calyx tube, sinuses V-shaped; corolla funnelform, 5.9–10.3 mm; tube 3–5.8 mm, white, glandular-pilose externally, sparsely hairy internally on distal tube; throat 1.5–2.6 mm, flaring, yellowish green to whitish green, glandular-pilose on external throat, glabrous internally, lobe 1.4–2.2 mm × 0.9–1.3 mm, lanceolate, acute and somewhat cuspidate, sparsely glandular-puberulent on abaxial surface, white with a violet patch along vasculature at juncture of proximal lobe and distal throat; stamens epipetalous, filaments diverging from corolla subequally, free portion subequal in length, 2.2–3.9 mm, sparsely hairy proximally, otherwise glabrous; anther 0.7–1 mm; pollen spheroidal, variable in size, 35.2–54.3 µm diam.; pantocolporate, apertures 22 to 28, ora circular, 3–5.2 µm in diam., sexine overlapping ora with irregularly angular colpi, 2.5–4.4 µm in diam.; exine ca. 2.5 µm thick; microreticulate, heterobrochate, the lumina 0.2–1 mm diam.; pollen cream-colored; ovary 0.9–1.9 mm tall, 0.4–0.7 mm broad, obovoidal, with a thickened stylar base, glabrous; style 5.4–8 mm, glabrous; stigma lobes 2, 0.3–0.4 mm, spreading when receptive; ovules one per locule, only one maturing and the locules not remaining distinct; nectary disk forming a 5-lobed collar at ovary base, 0.4–0.6 mm diam., rising 0.3 mm along the ovary, and 0.1–0.2 mm deep, pale green in color. Fruit 2.2–3.2 mm tall, 0.8–1.1 mm diam., straw yellow, capsule dehiscing loculicidally and septicidally from base, obovoidal, apiculate, apicule 0.3–0.7 mm; seed solitary, 2–3 mm long, 0.5–0.9 mm broad, narrowly obovoidal, golden to tan in color, seed surface smooth, anticlinal walls of seed coat only weakly visible, seed surface ornamentation not evident at 1000× or 10,000×; seed coat becoming mucilaginous when wetted, the outer periclinal walls separating, sometimes in large patches, each cell of the seed coat bearing a single, massive, helical spiricle; cotyledons 3, each deeply 2-lobed.

Distribution and IUCN Red List category. *Navarretia ojaiensis* is presently known from dry, clay soils of native perennial grasslands in openings of chaparral in the Ojai Valley, Santa Clarita Valley, and Santa Susana Mountains of Ventura County, California. Proximity of the latter locations and an unverified report from the Santa Monica Mountains suggest it occurs in Los Angeles County as well. A preliminary conservation assessment places this taxon in Red List Category DD (Data Deficient; IUCN, 2001) because long-term trends are unknown and surveys are needed to identify extant populations from throughout its distribution. At least some historically known populations from Ojai Valley have likely been consumed by development, and all but one of the recently identified populations from the Santa Clarita Valley and adjacent Santa Susana Mountains are likewise threatened by development; one population from this latter region lies in an area to be "conserved," but all sites in this region continue to be threatened by grazing.

Etymology. The specific epithet, literally "from Ojai," refers to the Ojai Valley of Ventura County, California, where many early collections of the species were made over a period of 30 years by Henry Pollard.

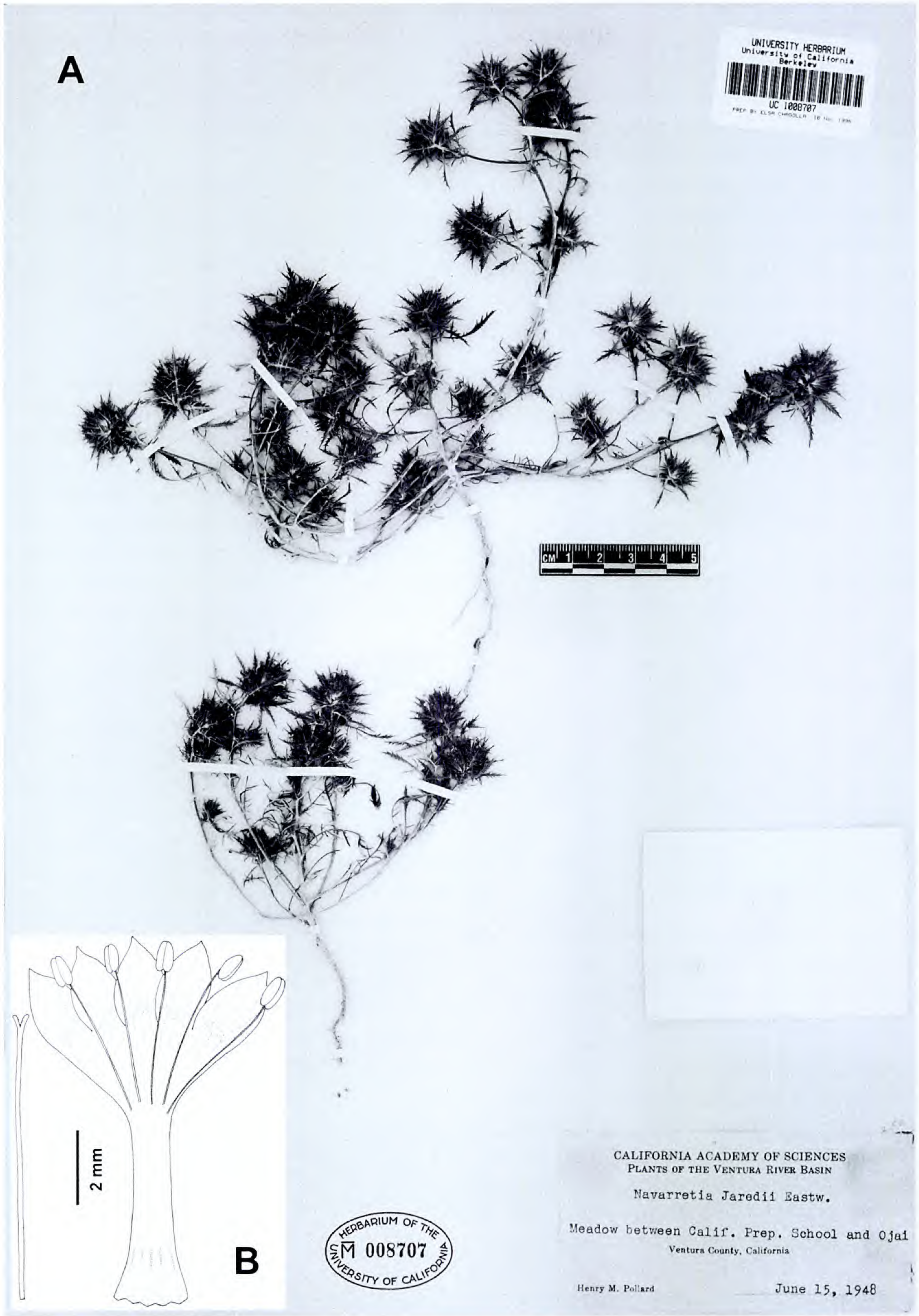

Figure 2. *Navarretia ojaiensis* Elvin, J. M. Porter & L. A. Johnson. —A. Photograph of holotype specimen (*Pollard s.n.*, UC). —B. (inset) Illustration of opened corolla with style, following post-pollination dehiscence and showing relative position of stamens and vasculature in corolla lobes and base (*Elvin 2930*, BRY).

Discussion. *Navarretia ojaiensis* is clearly similar to *N. mitracarpa* in its spreading habit but differs consistently in flower coloration and in the acuminate corolla lobes. *Navarretia ojaiensis* is similar to *N. gowenii* in flower coloration but differs in its spreading rather than primarily upright habit, its acuminate-cuspidate corolla lobes (rather than rounded-acute), long exserted stamens and exserted style,

a longer apical nipple on the fruit, in the proportionally shorter fusion of the calyx segments, and in the distance from the base that the three primary corolla lobe veins gradually diverge (greater than 1 mm), rather than the relatively abrupt divergence at or near (less than 0.5 mm) the base in *N. gowenii*.

Paratypes. U.S.A. **California:** Ventura Co., Foothills Trail, ca. 0.5 mi. W of Gridley Canyon Rd., Ojai Valley, 4 June 1970, *Henry M. Pollard s.n.* (RSA468364, SBBG39322); Hermosa Rd. near San Antonio Creek bridge at Camp Comfort, Ojai Valley, 9 June 1970, *H. M. Pollard s.n.* (CAS540889, RSA468363, SBBG40084); Foothills Trail, Ojai Valley, 8 May 1960, *H. M. Pollard s.n.* (CAS479004, SBBG37480); Santa Clarita Valley, hills N of SR 126, just W of Ventura/Los Angeles Co. line, Newhall Ranch, 9 June 2003, *M. A. Elvin 2930* (BRY, RSA); Santa Susana Mtns., N side of range in Salt Canyon watershed, Newhall Ranch, 12 June 2003, *M. A. Elvin 2941*(BRY, MO); Santa Susana Mtns., N side of range in Salt Canyon watershed, Newhall Ranch, 1 July 2003, *M. A. Elvin 2963* (BRY, RSA).

4. **Navarretia pubescens** (Bentham) Hooker & Arnott, Bot. Beechy Voy. 368. 1839. Basionym: *Aegochloa pubescens* Bentham, Bot. Reg. 19: under pl. 1622. 1833. *Gilia pubescens* (Bentham) Steudel, Nomencl. Bot., ed. 2 (Steudel) i: 684. 1840. TYPE: U.S.A. California: *D. Douglas 1833* (holotype, K digital image seen).

Navarretia erecta A. Heller, Muhlenbergia 1: 146. 1906. TYPE: U.S.A. California: Mendocino Co., near Ukiah, 11 July 1902, *A. A. Heller s.n.* (holotype, BKL not seen; isotypes, CAS, GH not seen, US, NY digital image seen).

Discussion. *Navarretia pubescens* is one of the earliest named species in this genus established in 1794, and it has the broadest distribution among species of the *N. pubescens* complex. The habit of this species is invariably erect, with plants either possessing a single axis or producing secondary, erect axes along the primary stem. A population from Contra Costa County, California, with white corolla lobes and tube is known (*Gowen 100*, BRY, JEPS), but this population has a purple throat (not simply with purple spots), long exserted stamens, and copious pubescence. In contrast, the other species in this complex have a white to cream throat and tube, with purple only present on the lobes, as a spot at the base of each petal associated with the veins, or both. The erect habit and colored throat of *N. pubescens* throughout its range contrast with the habit and corolla coloration of *N. mitracarpa* (see above), and these features are here used to exclude this later taxon from *N. pubescens*.

5. **Navarretia setiloba** Coville, Contr. U.S. Natl. Herb. 4: 153. 1893. TYPE: U.S.A. California: Kern Co., Kern River Valley, 900–1450 m, 23 June 1891, *F. V. Coville & F. Funston 1049* (holotype, US; isotype, UC).

Discussion. *Navarretia setiloba* circumscribes material possessing inner bracts with an expanded apical axis and only puberulent hairs on the stems, leaves, bracts, and calyces (a narrow band of longer trichomes is sometimes present on the bracts and calyces as indicated in the key above). This species is primarily localized to Kern County, California, where two morphotypes exist. A broad sample of individuals and populations of each morphotype is yet needed to determine the taxonomic significance of this variation. A collection initially determined as "*N. jaredii*" from Los Angeles County (*Porter 10913*, RSA) is morphologically congruent with, and indistinguishable in chloroplast DNA sequence from, the blue corolla-lobed form from Kern County. Additionally, some historical collections in Kern County have been annotated by A. Day as intermediate with *N. pubescens* (e.g., JEPS 41309) and merit further study.

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Taxonomic Novelties in *Rauvolfia* (Apocynaceae, Rauvolfioideae) from Brazil

Ingrid Koch

Programa de Pós-graduação em Biologia Vegetal, Universidade Estadual de Campinas, Cidade Universitária Zeferino Vaz, Caixa Postal 6109, CEP 13083-970, Campinas, São Paulo, Brazil. Present address: Universidade Federal de São Carlos, Avenida Darci Carvalho Dafferner, 200, Alto da Boa Vista, Caixa Postal 3031, CEP 18043-970, Sorocaba, São Paulo, Brazil. ingrid@ufscar.br

Luiza S. Kinoshita and Volker Bittrich

Departamento de Botânica, IB, Universidade Estadual de Campinas, Cidade Universitária Zeferino Vaz, Caixa Postal 6109, CEP 13083-970, Campinas, São Paulo, Brazil. luizakin@unicamp.br; volker@unicamp.br

Abstract. Descriptions and illustrations of three new Brazilian species of the genus *Rauvolfia* L. (Apocynaceae, Rauvolfioideae), *R. capixabae* I. Koch & Kinoshita-Gouvêa, *R. gracilis* I. Koch & Kinoshita-Gouvêa, and *R. pruinosifolia* I. Koch & Kinoshita-Gouvêa, are presented. *Rauvolfia blanchetii* A. DC., *R. mollis* S. Moore, and *R. divergens* Markgraf are newly synonymized under *R. ligustrina* Willdenow, *R. pernambucensis* Emygdio under *R. moricandii* A. DC., and *R. sessilifolia* S. Moore under *R. weddelliana* Müller Argoviensis. Lectotypes for *R. blanchetii* and *R. ternifolia* Kunth are designated; furthermore, comments to clarify the complicated typification of *R. ligustrina* and *R. ternifolia* are presented.

Resumo. São apresentadas descrições e ilustrações de três novas espécies brasileiras do gênero *Rauvolfia* L. (Apocynaceae, Rauvolfioideae), *R. capixabae* I. Koch & Kinoshita-Gouvêa, *R. gracilis* I. Koch & Kinoshita-Gouvêa e *R. pruinosifolia* I. Koch & Kinoshita-Gouvêa. *Rauvolfia blanchetii* A. DC., *R. mollis* S. Moore e *R. divergens* Markgraf são sinonimizadas à *R. ligustrina* Willdenow, *R. pernambucensis* Emygdio à *R. moricandii* A. DC., e *R. sessilifolia* S. Moore à *R. weddelliana* Müller Argoviensis. São designados lectótipos para *R. blanchetii* e *R. ternifolia* Kunth e são apresentados comentários para o esclarecimento da complexa tipificação de *R. ligustrina* e *R. ternifolia*.

Key words: Apocynaceae, Brazil, *Rauvolfia*, Rauvolfioideae.

The genus *Rauvolfia* L. belongs to the family Apocynaceae, subfamily Rauvolfioideae. Its species are distributed throughout the tropical regions of the world. Currently, 60 species are estimated to belong in the genus (Mabberley, 1997). They characteristically have whorled leaves and branches, hypocrateriform flowers, and generally small, drupaceous, variously syncarpous or apocarpous fruits with two pyrenes. Although flowers are morphologically bisexual, they can be functionally unisexual and the plants dioecious (Koch et al., 2002).

In a revision of the American species of *Rauvolfia*, Rao (1956) listed 34 species, 18 of them found in Brazil. Later, Mello Filho (1973) described two new species and reestablished a third one, formerly synonymized by Rao (1956).

The present study is the result of a new revision of the Neotropical species of *Rauvolfia* by Koch (2002), and it reports three taxonomic novelties from Brazil that have been found during this investigation.

1. Rauvolfia capixabae I. Koch & Kinoshita-Gouvêa, sp. nov. TYPE: Brazil. Espírito Santo: Linhares, Res. Cia. Vale do Rio Doce, 4 Nov. 1999, *V. F. Mansano, M. C. S. Rio, D. A. Folli & M. F. Freitas 79* (holotype, UEC; isotypes, CVRD, RB). Figure 1.

Ab omnibus speciebus americanis generis ramis dense lenticellatis, cataphyllis ad nodos ramorum floriferorum majoribus, ramis floriferis foliis juvenilibus instructis et inflorescentiis in nodis terminalibus et floribus albis, maculis rubris ornatis, corollis leviter zygomorphis et tubo ad 8 mm longo differt.

Trees (6–)12–15 m tall; branches in whorls of 3 or 4, densely lenticellate, young ones dark brown, older ones light brown; a short internode occurs above each node of normal leaves with lanceolate cataphyll, ca. 4.8 × 2 mm; slender colleters present in branch and

Figure 1. *Rauvolfia capixabae* I. Koch & Kinoshita-Gouvêa. —A. Branch. —B. Flower in longitudinal section. —C. Lateral view of the anther. —D. Style head. —E. Fruit. Drawn from the holotype, *Mansano et al. 79* (UEC). Scale bars: A = 3 cm; B = 2 mm; C, D = 0.5 mm; E = 5 mm.

inflorescence nodes; floriferous branches provided with juvenile leaves. *Leaves* anisophyllous, 4 or 5 in each node; the larger leaf in the node 5.5–12 × 2–3 cm, petioles 6–9 mm; the smaller leaf in the node 3–6.6 × 0.8–2.4 cm, petioles 5–7 mm; elliptic to obovate-elliptic, membranaceous to papery, leaf blades discolorous, glabrous on both sides, with acute to cuspidate apex, base attenuate and margin entire;

petiole flattened; central vein conspicuous on the abaxial side, secondary veins in 14 to 17 pairs, 5–9 mm distant from each other and curved toward the margin, with occasionally evident arches, tertiary veins immersed and scarcely evident on both sides. *Inflorescences* pleiochasial, whorled, occurring between the petioles, in the end of branches with a shoot in the terminal position, twice the size of its associated leaves, lax with 6 to 10 flowers; peduncle to 2–4 cm; bracteoles 1.5–2 mm, triangular to lanceolate with glandular-toothed margin; pedicels 1–1.4 cm; upper part of flower buds broadened and ovoid. *Flowers* with calyx lobes 2.5–3 × 1.5 mm, fused at the base, triangular, apex acute, margin entire, green; corolla hypocrateriform, slightly zygomorphic, white with red dots on the lobes; tube 5–8 × 1.5–2 mm, broadened in the upper 1/3, constricted below the throat orifice and at the region below the style head, pubescent inside; trichomes straight, becoming progressively longer from the bottom of the tube constriction to the base of the anthers (0.1–0.3 mm), and curved, long (ca. 0.5 mm), and moniliform above the anthers; lobes 3.5–4 × 1.5 mm, reflexed, obliquely ovate with rounded apices; anthers ca. 1 mm, apex located slightly below the throat orifice, apiculate, base touching the apical appendages of the style head; filaments curved, half the length of the anthers, callous at the apex; style head ca. 0.6 mm, main body cylindrical with a broadened portion at the middle, small trichome crown at the upper margin hiding 2 small appendages and a membranaceous skirt at the base; style 3–4.5 mm; ovary ca. 1.3 mm, oblong, slightly sulcate with a round apex, hemisyncarpous; nectariferous disc ca. 0.4 mm high, annular. *Drupes* partially syncarpic, ca. 2 × 1.5–3 cm, globose (if only one of the carpels is developed) to reniform (if both carpels are developed), green with white dots, epicarp surface lenticellate, endocarp ca. 1 × 1.5 cm, ovoid with surface rugose.

Distribution and habitat. The species occurs in the Atlantic Rainforest region throughout the Brazilian states of Espírito Santo and Bahia.

Phenology. Collected with flowers in November and with fruits from February to May.

Relationships. This arborescent species is recognizable by its large cataphylls or their scars above each node of normal leaves, the densely lenticellate branches with the inflorescences concentrated at the branches tips, and the slightly zygomorphic white flowers with red spots and a corolla tube up to 8 mm long. Specimens of this species have been previously identified as *Rauvolfia mattfeldiana* Markgraf, probably because large cataphylls and white flowers are common to both species, but *R. mattfeldiana* is an exclusively shrubby species that occurs in open places and presents smaller leaves and flowers, and completely white corollas.

Etymology. The species epithet refers to "capixaba," a word that is usually used for people born in the state of Espírito Santo, where the species was found for the first time and has been collected more frequently.

Paratypes. BRAZIL. **Bahia:** Uruçuca, Faz. Santa Cruz, W. W. Thomas, *A. M. de Carvalho & T. S. dos Santos 7008* (NY). **Espírito Santo:** Linhares, Res. Flor. CVRD, próximo ao escritório, *J. Spada 23/77* (MO), *A. L. B. Sartori, A. Sciamarelli, I. Koch, R. Goldenberg & V. F. Mansano 201* (UEC), *V. F. Mansano & D. A. Folli 57* (UEC); Santa Teresa, Est. Biol. Santa Lúcia, *L. Thomaz 731* (MBML, UEC), *733* (MBML, UEC), *737* (MBML, UEC), *738* (MBML, UEC).

2. Rauvolfia gracilis I. Koch & Kinoshita-Gouvêa, sp. nov. TYPE: Brazil. Rondônia: Faz. São Francisco de Assis, Km 654, estr. Vilhena–Pimenta Bueno, 6 Nov. 1979 (fl), *M. G. Vieira, R. H. Petersen, B. W. Nelson, J. F. Ramos & C. D. A. Mota 955* (holotype, INPA; isotypes, MO, NY, RB, US). Figure 2.

A *Rauvolfia weddelliana* Müller Argoviensis foliis ovatis, petiolis gracilibus, 1–1.9 cm, lamina foliari supra nitida, nervis secundariis congestis, 20- ad 25-jugatis differt; a *R. praecoci* K. Schumann ex Markgraf habitu suffrutescenti, inflorescentiis per ramum floriferum 6- ad 10-floris et tubis floralibus latioribus (2–2.7 mm diam.) differt.

Shrubs to small trees, 0.6–5 m tall; branches 3 to 4 in each verticil, lenticellate, young ones dark brown, older ones rugose and light brown; short internodes and cataphylls at the base of younger branches; triangular cataphylls occasionally evident, ca. 2 mm; toothed colleters in branch and inflorescence nodes. *Leaves* anisophyllous, 3 at each node, large ones 6.6–8.7 × 2–2.3 cm, petiole 1.6–1.9 cm; smaller ones 4.2–6.8 × 1.3–1.8 cm, petiole 1–1.9 cm; leaf blades membranaceous to papery, discolorous, glabrous on both sides, lustrous adaxially, elliptical to ovate-elliptical, apex acute to caudate, base acute to obtuse, margin slightly thickened; petiole flattened; primary vein thin, conspicuous abaxially, secondary veins immersed and occasionally evident adaxially, generally evident abaxially, in 20 to 25 pairs, 2–5 mm distant from each other, oblique with arches next to the margin. *Inflorescences* pleiochasial, whorled, occurring between the petioles, along branches, 1/2 to 2/3 the size of the largest associated leaf, lax, with 6 to 10 flowers; peduncle 0.7–3 cm; triangular bracteoles ca. 1.3 × 0.4–0.8 mm with entire or slightly

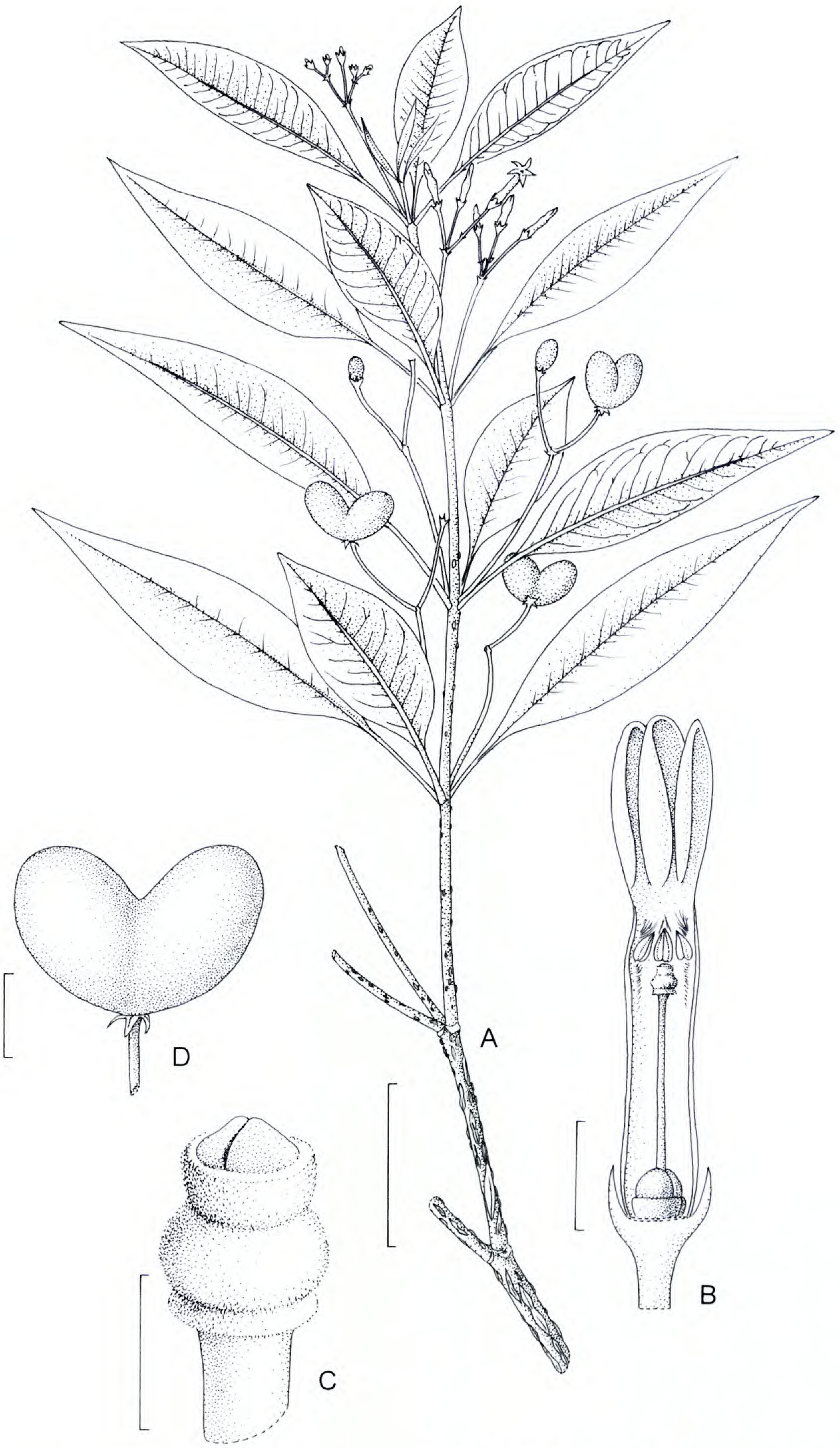

Figure 2. *Rauvolfia gracilis* I. Koch & Kinoshita-Gouvêa. —A. Branch. —B. Flower in longitudinal section. —C. Style head. —D. Fruit. Drawn from the holotype, *Vieira et al. 955* (INPA). Scale bars: A = 3 cm; B = 2 mm; C = 0.5 mm; D = 5 mm.

toothed margin; pedicel 4–9 mm; upper part of flower buds broadened and ovoid. *Flowers* with calyx with triangular lobes 1.5–2.5 × 1–4 mm, apex acute, fused at the base, margin entire or toothed, green; corolla hypocrateriform, pink; tube 4.4–6 × 2–2.7 mm, broadened at the upper 1/3, constricted below the throat orifice and at the region below the style head, pubescent inside with trichomes straight,

becoming progressively longer from the bottom of the tube constriction up to the base of the anthers (0.1–0.3 mm), and curved, long (ca. 0.5 mm), and moniliform above the anthers; lobes 2.5–3.5 × 2 mm, patent, ovate-oblique with rounded apex; anthers ca. 1 mm, the apex reaching slightly below the throat orifice, apiculate, the base touching apical appendages of the style head; filaments curved, 1/3 the length of the anthers, callous at the apex; style head ca. 0.7 mm, main body cylindrical with a broadened portion at the middle, small trichome crown at the upper margin that hides 2 small appendages and a membranaceous skirt at the base; style 1–1.3 mm; ovary 1–1.3 mm, subglobose, round apex, hemisyncarpic; nectariferous disc 0.4–0.6 mm high, annular. *Drupes* partially syncarpic, ca. 1.2 × 0.8 cm, ovoid (if one of the carpels is developed) to cordate (if both carpels are developed), green when immature and later red, epicarp surface smooth, endocarp rugose.

Distribution and habitat. This species is found throughout field and savanna locations, in sand or clay, in the central-western region of Brazil, from 530 to 900 m.

Phenology. Collected with flowers from June to November and with fruits in November.

Relationships. *Rauvolfia gracilis* is similar to *R. weddelliana* Müller Argoviensis in habit and flowers and to *R. praecox* K. Schumann ex Markgraf by its leaves. It can be differentiated from *R. weddelliana* by its smooth, slightly ovate leaves with thin petioles, 1–1.9 cm, lustrous adaxial face, secondary veins not very distant from each other, in 20 to 25 pairs, and vein reticulation not evident, whereas *R. weddelliana* has elliptical to obovate-elliptical leaves, subsessile, with the secondary veins more distant from each other, 11 to 16 pairs, and vein reticulation evident. It can be distinguished from *R. praecox* by its shrubby habit, inflorescences with smaller number of flowers (6 to 10 on each branch), and flowers with wider corolla tubes (2–2.7 mm). *Rauvolfia praecox* is a tree with inflorescences with more than 50 flowers on each branch and flowers with narrower corolla tubes (usually 1 mm).

Etymology. The species epithet refers to its slender petioles and delicate leaves that give the plant a delicate general aspect.

Paratypes. BRAZIL. **Mato Grosso:** Serra do Parecis, estr. Brasília–Acre, *B. Maguire, J. Murça-Pires, C. K. Maguire & N. T. Silva 56444* (NY, S, Z). **Rondônia:** estr. Porto Velho–Cuiabá, Km 645, *Hallard 13* (BR, K), *14* (BR); Vilhena, BR 364, rodovia Porto Velho–Cuiabá, Km 39, *C. A. Cid, J. Lima & J. Guedes 1464* (RB).

3. Rauvolfia ligustrina Willdenow, in Roemer & Schultes, Syst. Veg. 4: 805. 1819. TYPE: "In America Meridionalis," *Humboldt & Bonpland 1480* (holotype, B-W 5097 not seen, B-W photo at UEC [F 8424]).

Rauvolfia ternifolia Kunth, in Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 3: 232 (ed. quarto) 1819. TYPE: [Colombia.] "Crescit in ripa fluminis Magdalena, prope Mompox," *Humboldt & Bonpland 1480* (lectotype, designated here, P 844, P photo at UEC; isotypes, B†, B photos at F, GH, and NY [F 4475], P fragment at F).

Rauvolfia blanchetii A. DC., in DC., Prodr. 8: 340. 1844. Syn. nov. TYPE: Brazil. Bahia: Jacobina, Vila da Barra, Serra de Açurna, 1839, *Blanchet 2718* (lectotype, designated here, G; isotypes, BM, BR, F, F photos at F, G, K, and NY [F 51191], K photo at UEC).

Rauvolfia mollis S. Moore, Trans. Linn. Soc. London, Bot. 4: 393. 1895. Syn. nov. TYPE: Brazil. Mato Grosso: Nov. 1893, *S. Moore 950* (holotype, BM, BM photo at NY [NY 675]; isotypes, B not seen, B photos at F, GH, and NY [F 4465], K not seen, K photo at UEC).

Rauvolfia divergens Markgraf, Feddes Repert. Spec. Nov. Regni Veg. 20: 119. 1924. Syn. nov. TYPE: Paraguay. "Villa Sana entre Rio Apa e Rio Aquidaban," 21 Jan. 1909, *Fiebrig 4664* (holotype, M; isotypes, B†, B photos at F, GH, and NY [F 4460], G [3], K, K photo at UEC, L, M not seen, P not seen, S not seen).

Roemer and Schultes' *Rauvolfia ligustrina* and Kunth's *R. ternifolia* were described in the same year (1819) and were based on duplicates of the same material from the Humboldt and Bonpland collections that had been stored in the herbaria B-W and P-Bonpland. An article written by MacVaugh (1955) gives us some idea about the history of the material collected by Humboldt and Bonpland and the duplicate set first sent to Willdenow for analysis. MacVaugh (1955) reported all the problems and the misunderstandings that occurred after Willdenow's death because of the publication of new species by several authors without Humboldt's permission (Humboldt had given this task to Kunth after Willdenow's death). In the same publication, MacVaugh emphasizes the concern for priority, especially for those names published concomitantly by Roemer and Schultes and by Kunth, and the efforts of Kunth to record and solve those conflicts. MacVaugh lists Roemer and Schultes' species names that have priority over Kunth's species names and one of these is *R. ligustrina*. This list was based on a study by Kunth (1830 apud MacVaugh, 1955), who considered the dates of publication of both studies.

The information about type material of species differed in the original description of them. For *Rauvolfia ligustrina* a precise locality is not given, but Humboldt and Bonpland (s.n.) are cited as collectors. For *R. ternifolia* a precise locality is given but no

collectors cited, although they are implied. Fortunately, we were able to analyze photographs and copies of microfiches of the type material of both species, from the B-W and P-Bonpland herbaria. On the specimen of *R. ligustrina* from B-W we found that labels written by Willdenow carry original description data of *R. ligustrina*, as well as general information about the location ("In America Meridionalis") as cited in Roemer and Schultes' original description. This material also shows the inscription "Bonpland 1480," which was not reported, however, in the *R. ligustrina* protologue. Possibly, this is a later annotation. Furthermore, this specimen shows annotations of Markgraf and a label of Leeuwenberg, suggesting that it is the same type as the one of *R. ternifolia* ("= *R. ternifolia*"; "isotype of *R. ternifolia*"); however, Leeuwenberg's annotation erroneously depicts Ruiz and Pavón as the author of the species name. Another sheet, with the same collection number of Humboldt and Bonpland (1480), was also located among the photographs of the Berlin herbarium type material in the Field Museum negatives collection (F 4475). The photographs show the inscription "Rockefeller Foundation," this being the foundation that sponsored the project of photographing types in European herbaria between 1929 and 1931 (Grime & Plowman, 1986).

This material carries the same locality information as on the holotype of *Rauvolfia ternifolia* ("ripa fluminis Magdalena, prope Mompox") and is identified as *R. ternifolia*. Furthermore, it has an annotation with the information about Kunth's publication of *R. ternifolia* and a faint note "hb. Kunth." This was probably written by Kunth and suggests that the specimen was donated or analyzed by Kunth after the publication of *R. ternifolia*.

Probably neither Willdenow nor Roemer and Schultes examined the second specimen that was photographed at the Berlin herbarium, as the more detailed locality information is not mentioned in the original description of *Rauvolfia ligustrina*. This suggests that this specimen was not part of Willdenow's herbarium. It was probably destroyed during the fire that took place at the Berlin herbarium during World War II. We could not localize the holotype of *R. ternifolia* in the P-Bonpland collection at Paris. Two specimens of *R. ternifolia*, however, with the same collection number 1480 as on the specimen in B-W, were found in the general collection of the Paris herbarium. They were filed under *R. ligustrina* and had annotations by Rao identifying them as isotypes of *R. ternifolia*. We are not sure if Kunth used both specimens or only one (and if so, which one) for the description of *R. ternifolia*. The identification as *R. ternifolia*, however, has Kunth's handwriting. As we could not identify the holotype with certainty, we decided to designate one of these Paris specimens as the lectotype (P 844) for *R. ternifolia*.

Although neither Roemer and Schultes (1819) nor Kunth (1819) had made any mention of a collection number of Humboldt and Bonpland in the protologues of *Rauvolfia ligustrina* and *R. ternifolia*, respectively, the numbers used by Humboldt and Bonpland have proved to be consistent (Rodríguez & Greuter, 2001; Lack, 2004) even when the use of collection numbers was not then common among botanists (Lack, 2004).

Willdenow is considered the author of *Rauvolfia ligustrina* because there is a citation at the end of the protologue of the species, "Herb. Willd. Ms.," which indicates the intention of Roemer and Schultes to ascribe the name and the validating diagnosis to Willdenow (McNeill et al., 2007).

Rauvolfia ligustrina is a small shrub that can be easily recognized by its 3-verticillate oval-elliptical leaves with an acuminate apex, 1–7 × 1–3 cm, and by its tiny white flowers, with lanceolate-acuminate calyx lobes, as well as by its completely syncarpic fruit.

Observations on *Rauvolfia ligustrina* made by Rao (1956) pointed out that various synonyms of this species name resulted mainly from an erroneous interpretation of the variations found in the leaf, and that characters such as leaf size, flower number, and hair indument are rather variable, not permitting the distinction of different species. Rao (1956), however, earlier kept *R. blanchetii* and *R. mollis* as distinct species.

Rauvolfia mollis was separated from *R. ligustrina* mainly by its whitish hairs on the branches, leaves, and peduncles; its more abundantly branched inflorescences; and flowers with calyx lobes that are ovate, in contrast to the linear-lanceolate calyx lobes typical of *R. ligustrina*. Analyses of specimens of both species at first revealed a different pattern in material of *R. ligustrina* collected in Central America and the Antilles. Plants of this group show smaller leaves and appressed hairs only on veins and peduncles, while specimens collected throughout the central-western region of Brazil and in the eastern region of Paraguay have larger leaves and a dense whitish indument on leaves and peduncles, rarely only along the central vein and peduncles. Some exceptions, however, can also be noted among these specimens, which make the establishment of clear morphotypes more difficult. In addition, further analyses of specimens collected throughout the northern and northeastern regions of South America and Bolivia revealed a continuous variation of all characters used to distinguish *R. ligustrina* from *R. mollis*. The material from Bolivia often showed glabrous leaves or hairs only on the main vein, which was unexpected because

of the geographical proximity to the Paraguayan and central-western Brazilian populations. Our conclusion therefore is that there are no consistent morphological characters that separate both species, despite the disjunct distribution pattern; thus, *R. mollis* is synonymized under *R. ligustrina*.

Rao (1956) synonymized *Rauvolfia divergens* under *R. mollis*. We agree with Rao and consequently *R. divergens* is now listed under *R. ligustrina*, along with *R. mollis*.

Rao (1956) maintained *Rauvolfia blanchetii* as a separate species because it has a yellowish, densely tomentose indumentum on leaves and peduncles, ovate leaves with a mucronate apex, and flowers with ovate corolla lobes with an acute apex. The type material is from a semi-arid region in the Brazilian state of Bahia, and the dense indument, despite being evident and not common on individuals of *R. ligustrina* collected in less arid areas nearby, is not sufficient to accept *R. blanchetii* as a separate species. The remaining morphological features otherwise match the other character variations found among specimens of *R. ligustrina*, especially after the inclusion of *R. mollis*. Moreover, the geographic distribution of both species is continuous. Thus, *R. blanchetii* is included in *R. ligustrina*. The specimen *Blanchet 2718* (G) is here chosen from the syntypes cited in the protologue of *R. blanchetii* as the lectotype of the species, because this specimen is the most complete and well represented in herbarium collections.

4. Rauvolfia moricandii A. DC., in DC., Prodr. 8: 340. 1844. TYPE: Brazil. Bahia: *Blanchet 1007* (holotype, G-DC, G-DC photo at F and NY; isotypes, BM, G).

Rauvolfia pernambucensis Emygdio, Revista Brasil. Biol. 33(4): 513. 1973. Syn. nov. TYPE: Brazil. Pernambuco: Rio Formoso, Horto Florestal de Saltinho, *J. A. L. Falcão, W. A. Engler & E. Pereira 1208* (holotype, RB 89120).

Rao (1956) placed *Rauvolfia moricandii* in section *Rauvolfia* L., which is characterized, among other features, by leaves with intrapetiolar glands in the axil and on the petioles, corolla tube 2–3 mm long, and fruits fully syncarpous. At that time the species was rare among herbarium material and the author only had access to the type specimen. Rao (1956) commented that the species could be misplaced in that section because of the paucity of petiolar glands, the rather long corolla tube (4–5 mm), and a hemisyncarpous ovary and suggested that the morphological study of more specimens might shift the species to the section *Macrovolfia* (Pichon) A. S. Rao.

Later, Mello Filho (1973) described a new species, *Rauvolfia pernambucensis*, and compared it only with species from section *Macrovolfia*. He did not discuss similarities between *R. pernambucensis* and *R. moricandii*, possibly in consideration of the supposed presence of colleters on the petioles of *R. moricandii*. We found that the species are very similar, and we were unable to find colleters on the petioles of the type specimen of *R. moricandii*. The comparison of this species with *R. pernambucensis* did not point to any character that could support the maintenance of the latter name. Thus, *R. pernambucensis* is synonymized under *R. moricandii*.

5. Rauvolfia pentaphylla Ducke, Arch. Jard. Bot. Rio de Janeiro 3: 244. 1922. TYPE: Brazil. Pará: Óbidos, *A. Ducke s.n.* (lectotype, designated by Rao, 1956: 316, RB 13298; isotypes, B†, B photos at F, GH, NY, and RB [F 4471], BM 49462, G, MG 11038 not seen, MG photo at F, US 1040516).

Rauvolfia duckei Markgraf, Feddes Repert. Spec. Nov. Regni Veg. 20: 117 [in key], 121. 1924. TYPE: Brazil. Pará: Gurupá, s.d., *A. Ducke s.n.* (holotype, B†, B photo at F and GH [F 4661]; isotypes, BM 49463, G, MG 16544, RB 13299, US 1040928).

Rao (1956) placed *Rauvolfia duckei* as a synonym of *R. pentaphylla* because he believed that the diagnostic characters could be found within the morphological variation of *R. pentaphylla*. Mello Filho (1973) independently recognized *R. duckei* using quantitative floral characters. *Rauvolfia duckei* is here once more recognized as a synonym of *R. pentaphylla*. After examination of the type material of both species as well as of additional material, we agree with Rao (1956) that there is no morphological justification to consider *R. duckei* as a distinct species.

Markgraf (1924) cited *Ducke 16544* in the original description of *Rauvolfia duckei* but did not designate the herbarium of the holotype. A photograph of the material from B is kept in F and GH, and this was probably the holotype since Markgraf worked at the Berlin herbarium at that time. The specimen could not be located, however, and was probably lost during World War II. Examining the specimens among the isotypes, we noticed that the number associated with Ducke's name was not a collector number but a herbarium (MG) number. This misinterpretation by Markgraf in confusing this herbarium number with a collection number of Ducke has been previously made.

6. Rauvolfia pruinosifolia I. Koch & Kinoshita-Gouvêa, sp. nov. TYPE: Brazil. Minas Gerais: Governador Valadares, bacia do Rio Doce, I

June 1961, *G. M. Magalhães 18840* (holotype, PEL; isotypes, B, F, MG). Figure 3.

A *Rauvolfia grandiflora* Martius ex A. DC. habitu altitudine altiore, nodo verticillato in ramis floriferis unico, foliis fortiter anisophyllis, pruinosis, ceris crystallinis in lamellulis epicuticularibus vestitis, inflorescentiis brevioribus, 6- ad 12-floris et lobis corollae minoribus (2.5 mm longis) differt.

Tree, 10–15 m tall; branches 3 or 4 on each whorl, slightly lenticellate, younger branches dark brown, older branches paler brown; short internodes with cataphylls above each alternate node of leaves; triangular cataphylls inconspicuous, ca. 1.5 mm; slender colleters on branch and inflorescence nodes. *Leaves* strongly anisophyllous, 4 or 5 on each node, the smaller ones less than 1/2 the size of the larger ones; larger leaves 7–9.6(–12) × 2.5–3(–5) cm, petiole sessile or to 1.6 mm; smaller leaves 2.5–4.8 × 1–2 cm, sessile; leaf blades papery, discolorous, glabrous on both faces but pruinose in adaxial surface, elliptical to obovate-elliptical, apex acute to cuspidate, base attenuate, margin slightly revolute; primary vein narrow, conspicuous on both blade faces, secondary veins immersed, less evident adaxially, 3–7 mm distant each from other, curved toward the margins, 9 to 14 pairs. *Inflorescences* pleiochasial, whorled, between the petioles of whorled leaves, at the end of branches, 1/3 to 1/2 the size of largest associated leaf, lax, 6 to 12 flowers; peduncle 2–3 cm; bracteoles triangular, ca. 1 mm, with toothed margins; pedicel 4–6 mm; upper part of flower buds broadened, oval to oblong. *Flowers* with calyx with deltoid lobes, 1.5–2 × 1 mm, apex acute, margins entire to toothed, subglandular, green; corolla hypocrateriform, white with red spots on the lobes; tube ca. 15 × 2 mm, broadened in the upper 1/3, constricted below the throat at the region below the style head, pubescent inside with trichomes straight, becoming progressively longer from the beginning of the tube (0.1–0.3 mm), narrowing to the base of the anthers, long and moniliform above the anthers (0.5 mm); lobes ca. 2.5 × 1.5 mm, patent, oval with rounded apex; anthers ca. 1 mm with apiculate apex shortly below the orifice of the corolla tube, base touching the apical appendages of style head; filaments curved, 1/3 the size of the anthers and callous at the apex; style head ca. 0.6 mm, main body cylindrical, broad at the middle, with a small trichome tuft at the upper margin that hides the appendages and with a membranaceous skirt at the base; style ca. 5.8 mm; ovary subglobose, ca. 1.3 mm, syncarpous only at the base, with a rounded apex; nectariferous disc ca. 0.4 mm high, annular. *Fruit* not seen.

Distribution and habitat. Specimens of this species were collected only in the Governador Valadares region (Brazilian state of Minas Gerais), in forests located at the Rio Doce Basin and by a single collector. This suggests that the collections were made from perhaps only a single individual and the lack of other collections may place this species at a high extinction risk.

Phenology. Flowering from June to October.

Relationships. *Rauvolfia pruinosifolia* differs from *R. grandiflora* with a tree height of 10–15 m (there is one report of a 2-m-high shrub, probably from a young individual), and there is only one leaf whorl on floriferous branches. It shows strongly anisophyllous leaves, and the inflorescences are up to half the size of the largest associated leaf, with flowers that have corolla lobes to 2.5 mm long. *Rauvolfia grandiflora* bears more than one leaf whorl on the floriferous branch, only slightly anisophyllous leaves, and inflorescences that are slightly shorter to longer than the largest associated leaf, with flowers that have corolla lobes 4–8 mm long. Moreover, plants of *R. grandiflora* commonly form shrubs or small trees.

Etymology. Individuals of *Rauvolfia pruinosifolia* present epicuticular wax crystals that occur as plaques on the leaf surface; SEM studies (Koch et al., 1998) have revealed that such wax crystals are not found in any other Neotropical species of *Rauvolfia*. These waxes give the leaf a whitish powdery aspect, which is why the name *R. pruinosifolia* has been chosen for this species.

Paratypes. Brazil. **Minas Gerais:** Governador Valadares, *G. M. Magalhães 4431* (BM), *19185* (NY).

7. **Rauvolfia weddelliana** Müller Argoviensis, in Martius, Fl. Bras. 6(1): 32. 1860. TYPE: Brazil. "Entre Goiás e Cuiabá," *Weddell 2966* (lectotype, designated by Rao, 1956: 331, P not seen; isotype, F).

Rauvolfia sessilifolia S. Moore, J. Bot. 42: 103. 1904. Syn. nov. TYPE: Brazil. Mato Grosso: Sant'Anna da Chapada, *Robert 494* (holotype, BM; isotype, BM photo at NY [676]).

In Rao's revision (1956), *Rauvolfia sessilifolia* and *R. weddelliana* were kept separate although the author had seen only the photograph of the type material of *R. sessilifolia*. Later, Rao (in sched., *Robert 494*) suggests his intention to synonymize *R. sessilifolia* under *R. weddelliana*, after examining the type specimen of *R. sessilifolia*, which he identified as *R. weddelliana*. By analyzing the type material and other specimens of both species, their continuous morphological variation could be verified herein. The characters that were used to distinguish the species,

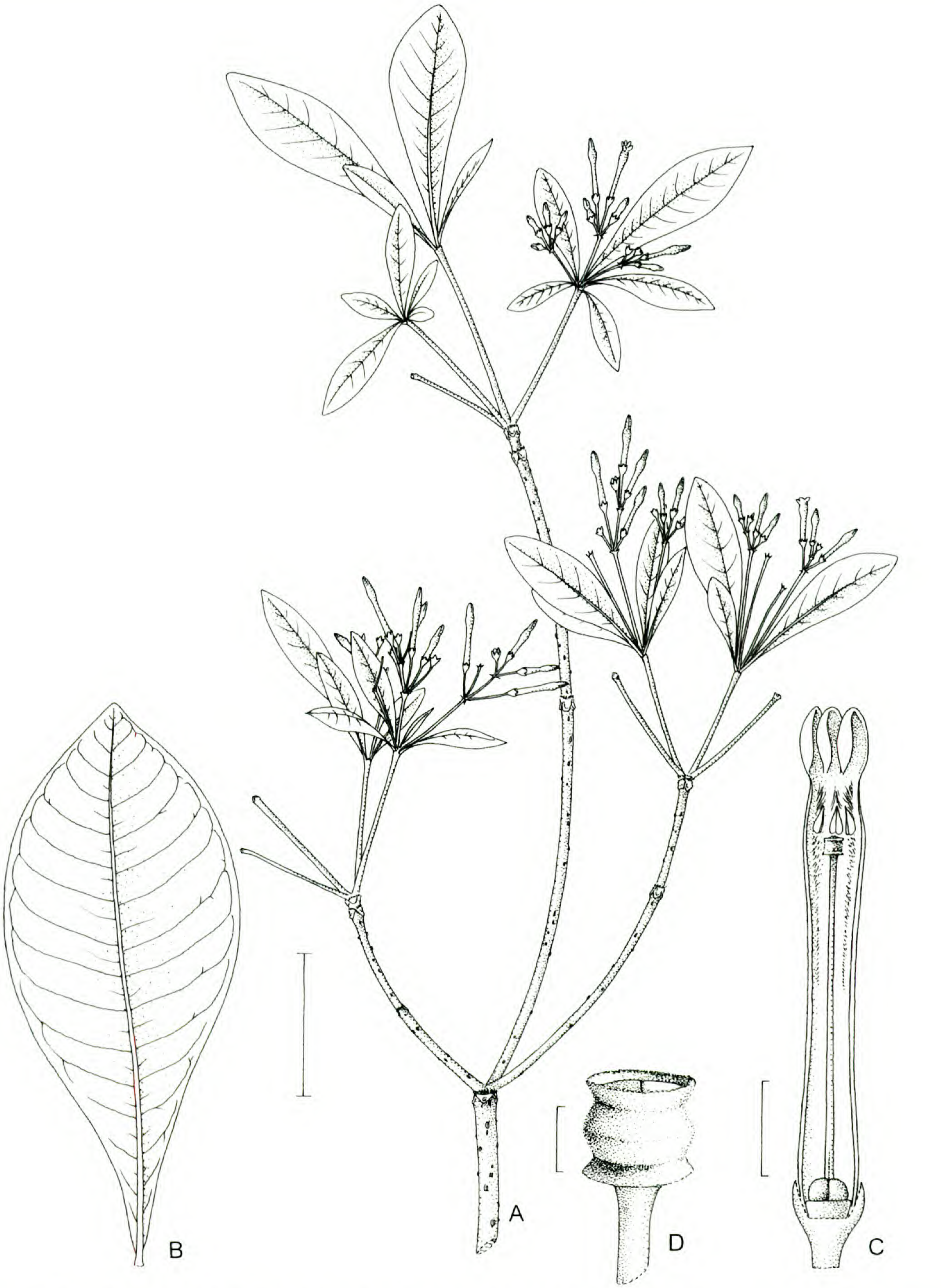

Figure 3. *Rauvolfia pruinosifolia* I. Koch & Kinoshita-Gouvêa. —A. Branch. —B. Large basal leaf in detail. —C. Flower in longitudinal section. —D. Style head. Drawn from the paratype, *Magalhães 4431* (BM). Scale bars: A, B = 3 cm; C = 2 mm; D = 0.5 mm.

such as the leaf shape and the calyx size, are variable even within a single population. Thus, *R. sessilifolia* is synonymized herein under *R. weddelliana*.

Specimens collected in the Serra do Cachimbo region, in the northern Brazilian state of Pará, present somewhat deviating morphological features, such as generally wide, elliptical leaves with less evident reticulation and terminal inflorescences with few flowers (8 to 12 flowers per inflorescence branch), whereas most individuals of *Rauvolfia weddelliana* from other regions present slightly obovate leaves with evident reticulation and ca. 30 flowers on each inflorescence branch. We did consider the possibility of erecting a new subspecies for the Serra do Cachimbo plants, which would also be supported by their disjunct distribution. After analyzing additional material, however, the existence of similar individuals at the Chapada dos Guimarães (state of Mato Grosso) region became evident (there are many collections of *R. weddelliana* from this region), as well as the existence of individuals with more typical features of *R. weddelliana* in the Serra do Cachimbo region. Therefore, we refrain from describing a new subspecies. We believe, however, that genetic studies of the populations of this species would greatly help future taxonomic decisions.

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Nomenclatural Alterations in Microlicieae (Melastomataceae)

Cristiana Koschnitzke

Departamento de Botânica, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, 20940-040, Rio de Janeiro, RJ, Brazil. criskos@mn.ufrj.br

Angela B. Martins

Departamento de Botânica, Instituto de Biologia, Universidade Estadual de Campinas, Caixa Postal 6109, 13083-970, Campinas, São Paulo, Brazil. amartins@unicamp.br

Abstract. With the recent taxonomic review of *Chaetostoma* DC., it was found that six species did not present the set of diagnostic features established to delimit the genus. *Chaetostoma* is characterized by sessile, keeled to subkeeled, overlapping, acute leaves and a trichome crown on the external apex of the length of the hypanthium. Three species of *Chaetostoma* are transferred to *Microlicia* D. Don: *M. acuminata* Naudin (*C. acuminatum* (Naudin) Cogniaux), *M. castrata* Naudin (*C. castratum* (Naudin) Cogniaux), and *M. oxyanthera* Naudin (*C. oxyantherum* (Naudin) Triana). Two new names are also proposed: *M. baumgratziana* A. B. Martins & Koschnitzke (*C. gardneri* Triana) and *M. semiriana* Koschnitzke & A. B. Martins (*C. luetzelburgii* Markgraf). The new combination *M. parvula* (Markgraf) Koschnitzke & A. B. Martins (*C. parvulum* Markgraf) is provided. The name *M. oxyanthera* Naudin is lectotypified herein.

Resumo. A recente revisão taxonômica de *Chaetostoma* DC. revelou que seis espécies não exibem as características diagnósticas estabelecidas para delimitar o gênero. *Chaetostoma* é caracterizado por apresentar folhas sésseis, carenadas a subcarenadas, imbricadas, pungentes, e coroa de tricomas no ápice externo do hipanto. Três espécies de *Chaetostoma* estão sendo transferidas para *Microlicia* D. Don: *M. acuminata* Naudin (*C. acuminatum* (Naudin) Cogniaux), *M. castrata* Naudin (*C. castratum* (Naudin) Cogniaux), e *M. oxyanthera* Naudin (*C. oxyantherum* (Naudin) Triana). Dois novos nomes estão também sendo propostos: *M. baumgratziana* A. B. Martins & Koschnitzke (*C. gardneri* Triana) e *M. semiriana* Koschnitzke & A. B. Martins (*C. luetzelburgii* Markgraf). A nova combinação *M. parvula* (Markgraf) Koschnitzke & A. B. Martins (*C. parvulum* Markgraf) é fornecida. O nome *M. oxyanthera* Naudin é aqui lectotipificado.

Key words: Brazil, *Chaetostoma*, Melastomataceae, *Microlicia*.

The tribe Microlicieae, belonging to the Melastomataceae, is comprised of genera whose species are largely restricted to the cerrado and campos rupestres vegetation of the southeastern and central-western regions in the Brazilian states of Minas Gerais, Goiás, and the Federal District, with several species also occurring in the northeastern plateau, especially in Bahia, at higher elevations, where the caatinga (a spiny deciduous forest formation characterized by a long dry season) gives way to the campos rupestres.

Traditionally comprised of 15 or 11 genera attributed by Cogniaux (1883, 1891) and later by Renner (1993), Microlicieae has recently been reevaluated by Almeda and Martins (2001) and Fritsch et al. (2004). Using morphological and molecular characters, these studies have proposed a more restrictive circumscription of the tribe to include only a clade comprising six genera: *Chaetostoma* DC., *Lavoisiera* DC., *Microlicia* D. Don, *Rhynchanthera* DC., *Stenodon* Naudin, and *Trembleya* DC.

Chaetostoma is endemic to Brazil, where it occurs mostly above 800 meters. All species in the genus are subshrubs that thrive on sandy soils or in rocky habitats. In a recent taxonomic review (Koschnitzke & Martins, 2006), *Chaetostoma* was defined by the following diagnostic characters: sessile, keeled to subkeeled, overlapping, acute leaves without glandular punctations; a trichome crown on the external apex of the hypanthium that remains intact after dehiscence; and a mature capsule exceeding the length of the hypanthium. In contrast, *Microlicia*, the genus with which *Chaetostoma* has sometimes been confused, generally has glandular-punctate leaves that are frequently flat and not keeled, hypanthia lacking the trichome crown at the apex, and a capsule that expands in width as it matures, thereby elevating the length of the hypanthium around the ovary.

Chaetostoma and *Microlicia* have long been considered to be closely related because they share typically 5-merous flowers, 3-locular ovaries, and reniform seeds. The traditional distinctions between

these two genera have been size dimorphism, not extending to shape, among stamens within a flower (dimorphic vs. isomorphic or nearly isomorphic stamens). *Chaetostoma* has two series of equal or subequal stamens, whereas *Microlicia* has the two series of stamens differing markedly from one another (Cogniaux, 1883).

In reviewing *Chaetostoma* (Koschnitzke & Martins, 2006), it was found that six species that do not bear the trichome crown on the hypanthium are better accommodated in the genus *Microlicia*.

For this reason, we here transfer three species of *Chaetostoma* to *Microlicia*. We also reinstate three species in *Microlicia*, the genus to which they had been attributed originally.

NAMES RECOGNIZED IN *MICROLICIA*

1. Microlicia acuminata Naudin, Ann. Sci. Nat., Bot., Sér. 3, 3: 179. 1845. *Chaetostoma acuminatum* (Naudin) Cogniaux, in Martius, Fl. Bras. 14(3): 35. 1883. TYPE: Brazil. Goiás: s. loc., s.d., *G. Gardner 3730* (holotype, G).

Chaetostoma acuminatum var. *ramosissima* Cogniaux, in Martius, Fl. Bras. 14(3): 35. 1883. Syn. nov. TYPE: Brazil. São Paulo: "Araracoara," May 1834, *L. Riedel 2211* (holotype, LE not seen; isotypes, BR, C, F, K, M, P not seen, P photo at UEC, W).

This species was initially described as *Microlicia acuminata* by Naudin (1845). Triana (1871) transferred *M. oxyanthera* Naudin to the genus *Chaetostoma* with no comments on the reason for such change. Simultaneously, this author synonymized in *C. oxyantherum* (Naudin) Triana two other species of *Microlicia* (*M. castrata* Naudin and *M. acuminata* Naudin). Cogniaux (1883) accepted this transfer to the genus *Chaetostoma* made by Triana. However, he considered the synonymized taxa as distinct species, thereby following the initial circumscription proposed by Naudin (1845): *C. acuminatum*, *C. castratum* (Naudin) Cogniaux, and *C. oxyantherum*. We confirm Naudin's recognition as above. Analyzing the available nomenclatural types, we concluded that *C. acuminatum* var. *ramosissima* is not sufficiently distinct to be accepted as a different taxon.

Microlicia acuminata has flat, oval leaves, does not bear a trichome crown on the external apex of the hypanthium, and displays several glandular punctations on the leaves, hypanthium, and calyx lobes, features commonly found in *Microlicia*.

2. Microlicia castrata Naudin, Ann. Sci. Nat., Bot., Sér. 3, 12: 230. 1849. *Chaetostoma castratum* (Naudin) Cogniaux, in Martius, Fl. Bras. 14(3): 36. 1883. TYPE: Brazil. Goiás: "entre Natividade e Conceição," Feb. 1840, *G. Gardner 3732* (holotype, P not seen; isotypes, BM, BR, F, G, K, P not seen, P photo at S, SP, UEC, W).

As in the previous case, the species was initially described as *Microlicia castrata* and later synonymized in *Chaetostoma oxyantherum* (Triana, 1871). *Microlicia castrata* has polysporangiate anthers and differs significantly from *M. acuminata*, which has, like the majority of angiosperms and presumably most Melatomataceae (Almeda & Martins, 2001), tetrasporangiate anthers.

This species also has flat, oval leaves, lacks a trichome crown on the hypanthium, and displays several glandular punctations, thereby justifying its exclusion from *Chaetostoma* and reinstatement in the *Microlicia*.

3. Microlicia oxyanthera Naudin, Ann. Sci. Nat., Bot., Sér. 3, 12: 230–231. 1849. *Chaetostoma oxyantherum* (Naudin) Triana, Trans. Linn. Soc. 28: 25. 1871. TYPE: Brazil. Goiás: Salinas, 3 May 1844, *H. A. Weddell 2166* (lectotype, designated here, P not seen, P photo at UEC; duplicate, F [fragment]).

Microlicia oxyanthera var. *albiflora* Naudin, Ann. Sci. Nat., Bot., Sér. 3, 12: 231. 1849. Syn. nov. TYPE: Brazil: s. loc., s.d., *H. A. Weddell 2605* (holotype, P not seen).

When Triana (1871) transferred *Microlicia acuminata*, *M. castrata*, and *M. oxyanthera* to the genus *Chaetostoma*, recognizing them under the same taxon (*C. oxyantherum*), he used the *oxyantherum* epithet instead of *acuminatum*, which, being older, would have had priority. Cogniaux (1883), while agreeing with Naudin (1849), considered these species distinct, but kept them in *Chaetostoma* as did Triana (1871).

Microlicia oxyanthera and *M. castrata* are similar in that they lack glandular punctations on the hypanthium, but share the aristate calyx lobe apex by the extension of the median nerve. In addition, *M. castrata* and *M. oxyanthera* share polysporangiate anthers, a feature observed by Baumgratz et al. (1996) for *Chaetostoma luetzelburgii* Markgraf and *C. parvulum* Markgraf, which are also transferred to *Microlicia* in this paper. Therefore, in transferring those species to *Microlicia*, all species so far accepted in *Chaetostoma* present tetrasporangiate anthers.

NEW NAMES AND COMBINATION IN *MICROLICIA*

1. Microlicia baumgratziana A. B. Martins & Koschnitzke, nom. nov. Replaced name: *Chaeto-*

stoma gardneri Triana, Trans. Linn. Soc. 28: 25. 1871, non *Microlicia gardneri* Naudin, Ann. Sci. Nat., Bot., Sér. 3, 12: 240. 1849. TYPE: Brazil. Piauí: 1839, *G. Gardner 2853* (holotype, BM; isotypes, BR, F, G, P not seen, P photo at F, W).

This species has flat, lanceolate, subulate, nonacute leaves with slightly revolute margins, and glandular punctations. The hypanthium does not have the trichome crown on the external apex, which particularly excludes it from *Chaetostoma*.

Only the type collections of *Chaetostoma gardneri* were available for study, and to our knowledge, no other material is known. In a partial survey of the species of *Microlicia* known from the states of Piauí and Pernambuco, no other specimens display the diagnostic features of this species.

The new name, *Microlicia baumgratziana*, is provided because the basionym is already occupied by *M. gardneri* Naudin, a synonym of *M. vestita* DC. (de Candolle, 1828). The epithet pays homage to José Fernando Baumgratz, a researcher from the Botanical Garden of Rio de Janeiro, who has dedicated himself to the study of the Melastomataceae.

2. Microlicia parvula (Markgraf) Koschnitzke & A. B. Martins, comb. nov. Basionym: *Chaetostoma parvulum* Markgraf, Notizbl. Bot. Gart. Berlin-Dahlem 10(91): 44. 1927. TYPE: Brazil. Bahia: Rio de Contas, July 1913, *P. Luetzelburg 273* (holotype, M).

Glaziou (1908: 242–243) mentioned the name *Microlicia parvula* for a species collected in the state of Goiás without supplying a description or diagnosis, thereby creating a nomen nudum.

Markgraf (1927) mentioned in his description of *Chaetostoma parvulum* that it seemed more like a species of *Chaetostoma* with the appearance of *Microlicia*. This species is very similar to *M. semiriana* in that both lack the trichome crown on the hypanthium, the leaves are flat and ovate, and the flowers are yellow. The entire plant is glandular-punctate and glutinous.

Representative specimens examined. BRAZIL. **Bahia:** Água de Rega, Serra de Água de Rega, *Irwin et al. 30957* (BR, C, F); Água Quente, Pico das Almas, vertente oeste, trilha do povoado da Santa Rosa, 23 km ao O das cidade, *Harley 27061 & Taylor* (UEC, US); Piatã, próximo à Serra do Gentio, entre Piatã e Serra da Tromba, *Lewis et al. 7364* (SPF, US); Rio de Contas, Pico das Almas, vertente leste, subida do Pico do Campo do Queiroz, *Harley 26425* (UEC).

3. Microlicia semiriana Koschnitzke & A. B. Martins, nom. nov. Replaced name: *Chaetostoma luetzelburgii* Markgraf, Notizbl. Bot. Gart. Berlin-Dahlem 10(91): 43. 1927, non *Microlicia luetzelburgii* Markgraf, Notizbl. Bot. Gart. Berlin-Dahlem 10(91): 45. 1927. TYPE: Brazil. Bahia: Morro do Carrasco, s. loc., s.d., *P. Luetzelburg 263* (holotype, M).

The name *Microlicia luetzelburgii* was previously used by Markgraf (1927) to describe another species occurring in the Brazilian state of Piauí. Therefore, the epithet was changed to *semiriana*, as a tribute to João Semir, a researcher in the area of taxonomy at the State University of Campinas and a Brazilian specialist in the Melastomataceae.

Markgraf (1927) noted that *Chaetostoma luetzelburgii* is similar to other *Microlicia* species, yet he placed it in *Chaetostoma* because the stamens of the two cycles are almost identical in size and shape. Actually, the antesepalous and antepetalous stamens of this species are more similar to one another than in any other *Chaetostoma* species. However, when considering other features such as the nonacute, glutinous leaves, the absence of the trichome crown at the hypanthium apex, and the mature fruits not exceeding the length of the hypanthium, this species is better placed in *Microlicia*.

Representative specimens examined. BRAZIL. **Bahia:** Mucugê, betw. 10–15 km N of Mucugê on rd. to Andaraí, *Harley 18863* (CEPEC, SPF, UEC); Piatã, estrada entre Piatã e Abaíra, a 3 km ao S de Piatã, *Mori & Funch 13389* (CEPEC, US); Rio de Contas, 10 km N of town of Rio de Contas on rd. to Mato Grosso, *Harley 15270* (MO); Pico das Almas, vertente leste, subida do Pico do Campo do Queiroz, *Harley et al. 26177* (US).

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First Record of the Genus *Oryctina* (Loranthaceae) in Mesoamerica: *O. costaricensis*, a New Species from Costa Rica

Job Kuijt

Department of Biology, University of Victoria, Victoria, BC V8W 3N5, Canada. jkuijt@uvic.ca

ABSTRACT. *Oryctina costaricensis* Kuijt (Loranthaceae), from the Osa Peninsula of Costa Rica, is described and illustrated. It represents the first record of the genus in Mesoamerica, the remainder of the genus being South American.

Key words: Costa Rica, Loranthaceae, Mesoamerica, *Oryctina*.

Among the several Neotropical small-flowered genera of Loranthaceae, the genus *Oryctina* Tieghem may well possess the smallest flowers. It is characterized by indeterminate inflorescences bearing pairs of bracteolate, sessile flowers, each solitary in the axil of a scale leaf. Two recently collected fruiting specimens from the Osa Peninsula, Costa Rica, have turned out to be a new species of the genus which is here registered.

Oryctina costaricensis Kuijt, sp. nov. TYPE: Costa Rica. Puntarenas: Cantón de Osa, Peninsula de Osa, R.F. Golfo Dulce, Rancho Quemado, Sector Sureste, 8°40′50″N, 83°33′00″W, 250 m, 16 Sep. 1992, *J. Marin & D. Marin 521* (holotype, LEA; isotypes, CR not seen, MO not seen, INB not seen). Figures 1, 2.

Planta foliosa, glabra; rami juniores leviter angulati, vetustiores teretes. Folia opposita plus minusve obovata, usque ad 7.5 × 3.5 cm, in apice obtusa. Inflorescentia spicata, indeterminata, terminalis et ad axillas foliorum interposita. Flores bisexuales bracteolatae.

Plants to ca. 25 cm high, with epicortical roots only at the base, glabrous except for 2 conspicuous furfuraceous lines on the 2 keels of the young, carinate internodes; older stems ± terete except for the 2 persisting, now essentially smooth ridges but bearing numerous small, pustular, cinnamon-brown lenticels; basal epicortical roots present. Leaves to 7.5 × 3.5 cm, lanceolate to nearly elliptical, thin, apex mostly rounded, base obtuse; petiole ca. 5 mm, distinct; venation pinnate, rather obscure. Inflorescence to 5 cm, slender, both terminal and axillary, keeled with narrow furfuraceous ridge-lines, consisting of up to 10 internodes, some axillary inflorescences with 1 or 2 pairs of sterile scale leaves below; each inflorescence a spike of paired, sessile, bisexual flowers. Mature bud ca. 3.5–4 mm, 1 mm of which is the ovary with smooth calyculus, apex nearly acute; petals 6, dimorphic; flower subtended by 1 mm triangular to acute bract and 2 exposed triangular bracteoles ca. 0.5 mm; stamens dimorphic, the 2 anther series not overlapping; filaments ca. 0.5 mm, stout, terete, extending downward into thickened petal portion; pollen sacs 4, ca. 0.5 mm, the anther surmounted in a fleshy connectival horn that on lower anthers is as long as the anthers and acute, on higher anthers 1/2 as long and nearly blunt-tipped; style terete, somewhat indented by the anthers, stigma indistinct, finely papillate. Fruit ca. 9 × 4 mm, narrowly obovoid, with nearly invisible calyculus.

Oryctina costaricensis is a morphologically distinctive but apparently inconspicuous species, the only known member of its genus in Mesoamerica. The solitary, sessile flowers, flanked by triangular bracteoles and arranged on an indeterminate spike, firmly place the species in *Oryctina*. The related South American genus *Cladocolea* Tieghem generally has tetramerous flowers and lacks floral bracteoles, the inflorescence being mostly determinate. Within the present genus, *O. costaricensis* shows clear affinities with *O. pedunculata* (Kuijt) Kuijt and *O. badilloi* (Ferrari) Kuijt. It differs from those species in its very different leaf shape, the presence of terminal inflorescences, inflorescences with 10 or more flower pairs, strongly dimorphic connectival horns, and a much less distinct stigma. *Oryctina pedunculata* and *O. badilloi* are presently known only from Venezuela, more than 1000 km to the east. If, as recently has been intimated (Kuijt, 2000), the genus *Maracanthus* Kuijt needs to be revived, a transfer to that genus will be necessary. (*Oryctina pedunculata* is stated to be dioecious, but I do not consider that securely established.)

It seems appropriate to draw attention to the Osa Peninsula as having an unusual assemblage of Loranthaceae with strong South American affinities. Recent collections have documented the existence there of *Psittacanthus acinarius* (Martius) Martius and *P. cucullaris* (Lamarck) G. Don, both of which are otherwise strictly South American, unknown even from intervening Panama. *Psittacanthus costaricensis*

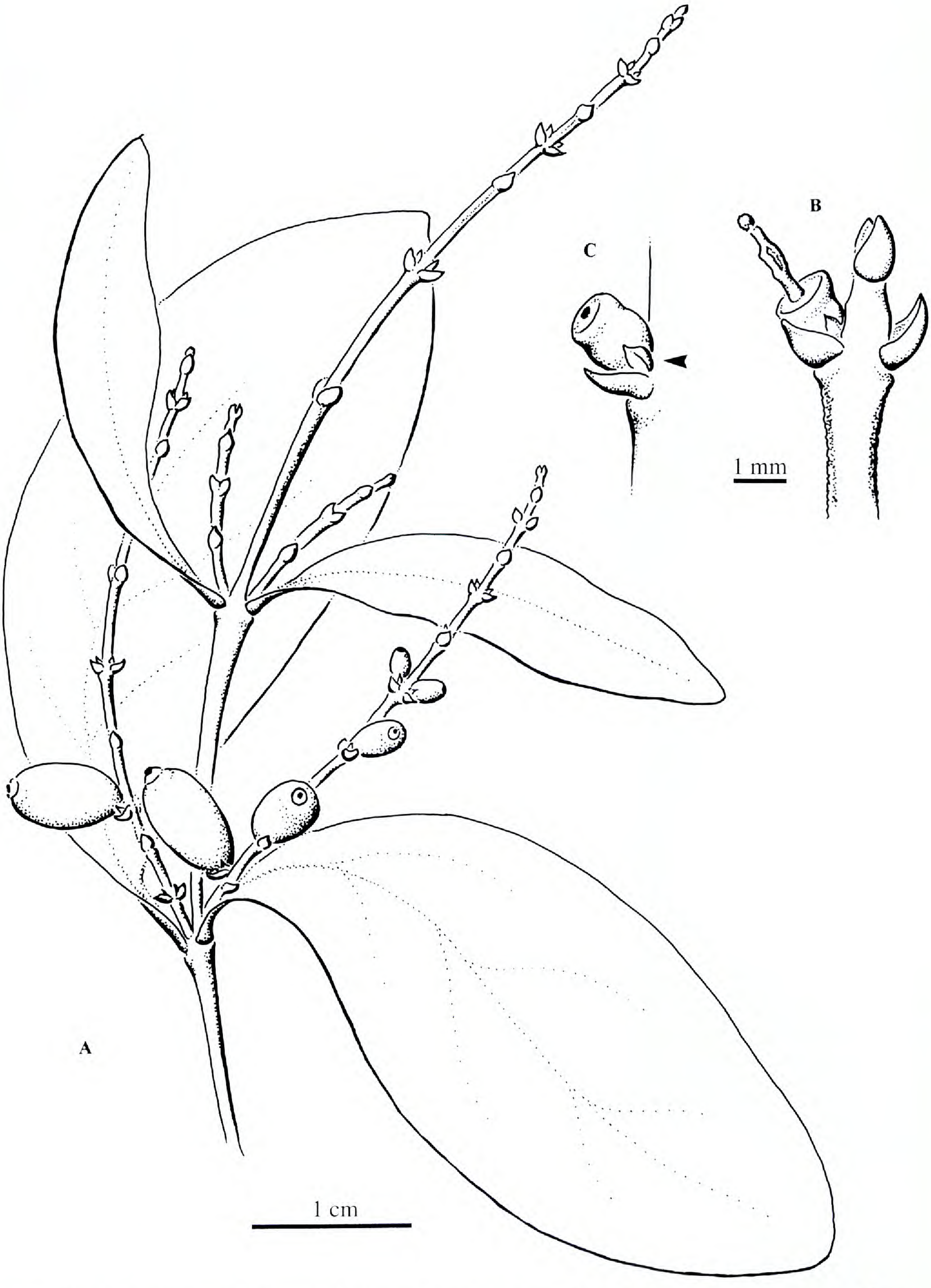

Figure 1. *Oryctina costaricensis* Kuijt. —A. Habit, partly reconstructed. —B. Inflorescence tip with remnant of flower. —C. Young fruit (arrow indicates bracteole). Drawn from the holotype, *Marin & Marin 521* (LEA).

Kuijt, also known from the same area and related to South American species, provides a third example of this distributional pattern. Finally, an undescribed species of *Psittacanthus* with clear South American affinities, also from the Osa Peninsula, will be described in my forthcoming monograph of that genus (Kuijt, in prep.). I have no explanation for this unusual concentration of South American elements on the

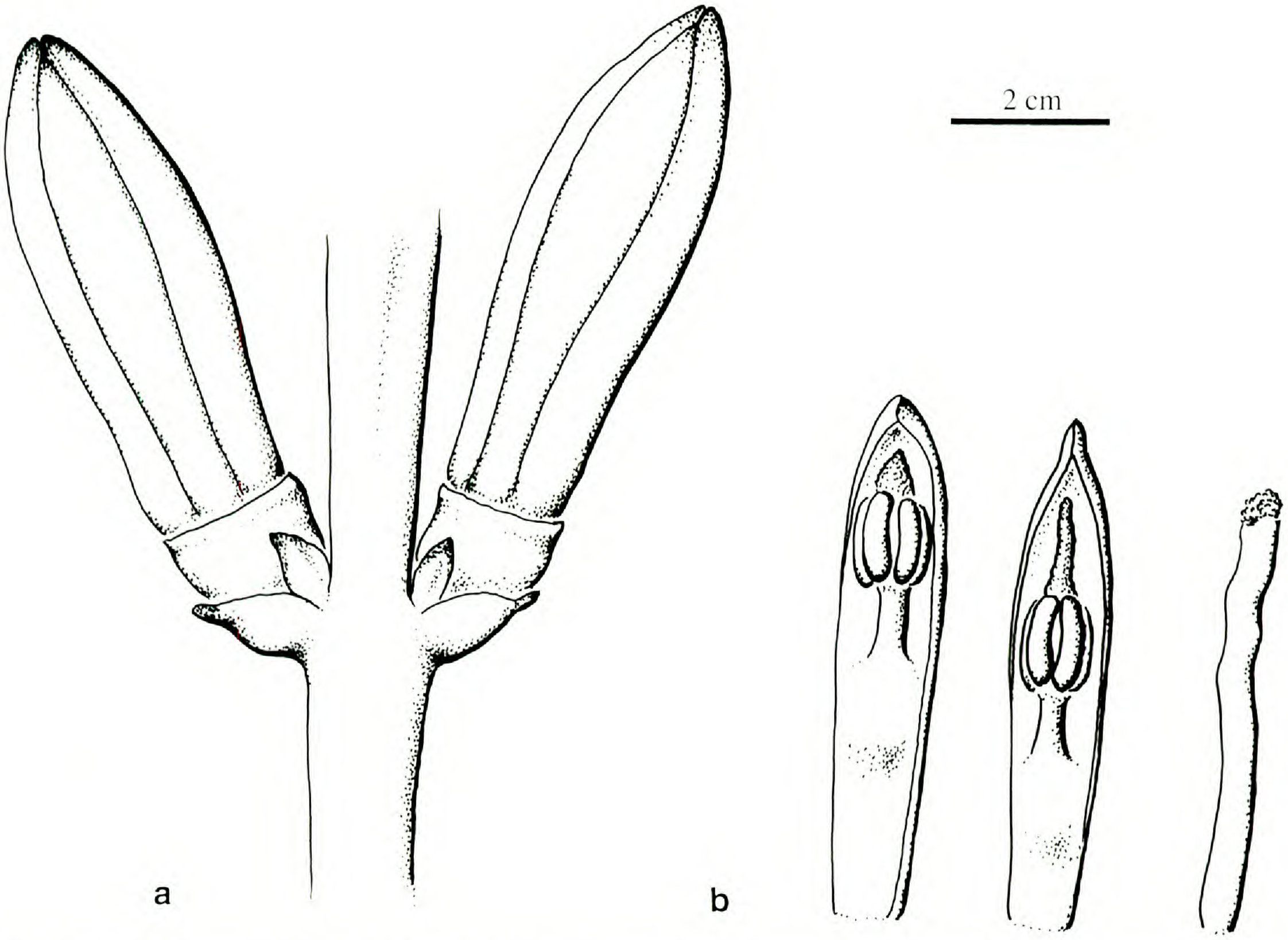

Figure 2. *Oryctina costaricensis* Kuijt. —a. Mature buds. —b. Floral dissection showing petal and stamen dimorphism and style. Drawn from the paratype, *Aguilar 573* (INB).

Peninsula, but a connection to avian flyways may be suspected. The geographic position of *Oryctina costaricensis* lies at least 800 km from its nearest congener, *O. chlamydata* (Rizzini) Kuijt (Kuijt, 1976). It is true that mistletoe seeds pass through the avian digestive tract rapidly, thus limiting dispersal (Kuijt, 1969; Barlow & Schodde, 1993). However, authentic instances of long-distance dispersal do exist, as in *Phoradendron berteroanum* (DC.) Grisebach on the Galápagos Islands (Kuijt, 2003). The possibility of seeds adhering to feathers and thus being carried over long distances also exists (Kuijt, 1969). Most species of *Oryctina* are highly limited in their geographic distribution, and *O. costaricensis* fits that pattern.

Paratype. COSTA RICA. **Puntarenas:** Osa, Reserva Forestal, Golfo Dulce, Rancho Quemado, 400–500 m, *R. Aguilar 573* (INB).

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New Species of *Corydalis* (Fumariaceae) from China II

Magnus Lidén
Botaniska trädgården, Villavägen 8, 752 36 Uppsala, Sweden. magnus.liden@botan.uu.se

Su Zhi-Yun
Kunming Institute of Botany, Heilongtan, Kunming, People's Republic of China

Abstract. Twenty-three species and one subspecies of *Corydalis* DC. (Fumariaceae) from China and Tibet are described as new to science: *C. aeditua* Lidén & Z. Y. Su, *C. cheilosticta* Z. Y. Su & Lidén, *C. cryptogama* Z. Y. Su & Lidén, *C. dolichocentra* Z. Y. Su & Lidén, *C. gymnopoda* Z. Y. Su & Lidén, *C. heterothylax* C. Y. Wu ex Z. Y. Su & Lidén, *C. ischnosiphon* Lidén & Z. Y. Su, *C. jiulongensis* Z. Y. Su & Lidén, *C. lagochila* Lidén & Z. Y. Su, *C. longistyla* Z. Y. Su & Lidén, *C. lophophora* Lidén & Z. Y. Su, *C. madida* Lidén & Z. Y. Su, *C. mediterranea* Z. Y. Su & Lidén, *C. milarepa* Lidén & Z. Y. Su, *C. nematopoda* Lidén & Z. Y. Su, *C. nubicola* Z. Y. Su & Lidén, *C. papillosa* Z. Y. Su & Lidén, *C. procera* Lidén & Z. Y. Su, *C. sarcolepis* Lidén & Z. Y. Su, *C. sophronitis* Z. Y. Su & Lidén, *C. tenuipes* Lidén & Z. Y. Su, *C. virginea* Lidén & Z. Y. Su, *C. yaoi* Lidén & Z. Y. Su, and *C. cheilosticta* subsp. *borealis* Lidén & Z. Y. Su. Six previously recognized subspecific taxa are raised to specific rank, and three of these are provided with new names: *C. microflora* (H. Chuang) Z. Y. Su & Lidén, stat. nov. [= *C. flexuosa* var. *microflora* H. Chuang], *C. mucronipetala* (H. Chuang) Lidén & Z. Y. Su, stat. nov. [= *C. flexuosa* var. *mucronipetala* H. Chuang], *C. omeiana* (C. Y. Wu & H. Chuang) Z. Y. Su & Lidén, stat. nov. [= *C. flexuosa* var. *omeiana* C. Y. Wu & H. Chuang], *C. amplisepala* Z. Y. Su & Lidén, nom. et stat. nov. [= *C. pseudomucronata* var. *cristata* C. Y. Wu], *C. harry-smithii* Lidén & Z. Y. Su, nom. et stat. nov. [= *C. elata* subsp. *ecristata* C. Y. Wu], and *C. pseudomairei* C. Y. Wu ex Z. Y. Su & Lidén, nom. et stat. nov. [= *C. mairei* var. *megalantha* C. Y. Wu].

Key words: China, *Corydalis*, Fumariaceae, IUCN Red List.

During the past couple of decades, many new Chinese species of *Corydalis* DC. (Fumariaceae) have come to light, some based on recently collected material and others on material that was previously unnoticed in herbaria in China and abroad. Several of these species were described by Wu Cheng-Yih, Zhuang Xuan, and ourselves during the preparatory work for *Flora Republicae Popularis Sinicae*, Volume 32, but others have not yet been formally recognized. Several more species need to be described, and we believe that additional undiscovered species exist. We have personal field experience for seven of the species described here, and for another four we have had access to field photographs, but most descriptions are based solely on herbarium specimens.

The style of the descriptions is similar to that of "New species of *Corydalis* from China I" (Su & Lidén, 1997). The sequence of subgenera, sections, and series is systematic, following that of the *Flora of China*, but in each subgeneric taxon the species are treated alphabetically. Phenology and distribution are summarized in separate paragraphs when more than one collection are known for a species.

IUCN Red List categories cannot be assigned to most taxa, due to data deficiency. However, it is preliminarily concluded that *Corydalis madida* Lidén & Z. Y. Su and *C. aeditua* Lidén & Z. Y. Su are vulnerable, due to their existence as very small populations in extreme habitats (in seepage water on steep cliffs), and probably also *C. virginea* Lidén & Z. Y. Su, due to heavy exploitation pressure of the area.

Section *Strictae* (Fedde) Wendelbo

1. Corydalis longistyla Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan: Dege, 3600 m, 22 June 1974, *Sich. coll. 7074* (holotype, CDBI; isotype, PE).

Herba perennis glauca glabra; caulis foliatus ramosus, foliis ovatis sub-bipinnatisectis, foliolis integris vel plus minusve profunde divisis, lobis obovatis vel subflabellatis. Racemi 15–40-flori, in statu fructifero elongati; bracteae anguste lanceolatae, pedicellis (4–9 mm longis) breviores usque aequantes. Flores lutei, apice distincte apiculati, calcaribus brevibus obtusis. Capsula oligosperma stylo longo.

Perennial glaucous glabrous herb; stems probably few from stout base with remnants of dead leaf bases, 35–45 cm, erect, with 7 to 10 leaves scattered along

stem; branches mainly from upper leaves. Leaf lamina ovate in outline, 3–10 × 1.5–4 cm, sub-bipinnatisect with 3 pairs of broadly ovate leaflets, deeply cut into obtuse, sometimes slightly overlapping lobes 2–5 mm broad; petioles 1–7 cm; petiolules 1–10 mm (uppermost leaves progressively smaller and shortly stalked). Racemes terminal on stems and branches (occasionally 1 or 2 lateral), unbranched, dense, shortly stalked, 15- to 40-flowered, elongating to up to 13 cm in fruiting stage; bracts narrowly lanceolate, 2–6 mm; pedicels thin, 4–9 mm. Flowers yellow; sepals ovate, acute, shallowly dentate, 2.5–3 × 1.5 mm; upper petal ca. 14 mm long, ecristate, apiculate, with very short rounded spur to 3 mm. Capsule (including style) ca. 20 mm, 2- to 4-seeded, ± constricted between the seeds, gradually attenuate apically and terminated by ca. 5 mm style (the seedless narrow apical portion of the capsule is together with the style 7–10 mm long); seeds 1.75–2 mm, strongly keeled, smooth, beaked, with short elaiosome.

Etymology. The epithet is derived from Latin "longus" (long) and "stylus" (style), referring to the long slender fruit apex.

Relationships. Corydalis longistyla clearly belongs in section *Strictae* (glaucous glabrous perennial; bracts small, lanceolate, scarious; petals yellow; spur short, saccate; stigma with small body and 10 long papillae; capsules nonexplosive) and is most similar to *C. krasnovii* Michajlova. From this species it deviates in the apiculate (vs. non-apiculate) flowers with even shorter spur (to 3 mm vs. 3–4 mm). It differs from *C. pseudomicrophylla* Z. Y. Su and *C. bibracteolata* Z. Y. Su in the simple racemes and very short spur, from *C. adunca* Maximovicz in the broad leaf lobes, and from all four mentioned species in the fruit, which is conspicuously constricted (vs. not constricted) between the fewer seeds (2 to 4 vs. 5 to 9).

IUCN Red List category. Corydalis longistyla should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Paratype. CHINA. **Sichuan:** Dege, 3160 m, 11 July 1979, *s. coll. 0277* (CDBI).

Section *Sophorocapnos* (Turczaninow) Fukuhara & Lidén

2. Corydalis cryptogama Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan [or possibly Hubei]: Daxian, Dazhu, Shuang-gong Gongshe, sunny hillside, 600–700 m, 25 May 1978, *Herbal exp. of Daxian pref. 0275* (holotype, SM).

Herba verisimiliter annua; caulis foliatus ramosissimus, foliis bipinnatisectis, foliolis integris vel plus minusve profunde trifidis, lobis ovatis dentatis. Racemi densiflori in statu fructifero elongati; bracteae rhombico-obovatae plerumque acuminatae, pedicellos breves aequantibus vel iis duplo longiores. Flores albidi minutissimi non calcarati, ad apicem capsulae (maturae fusiformis) subpersistentes. Semina ca. 1.75 mm longa ac lata rotundata non carinata tuberculata, elaiosomatibus planis membranaceis facile cadentibus instructa.

Herb, probably annual, with branched leafy angular stems up to 20 cm. Leaves broadly ovate in outline, bipinnate with 3 to 4 pairs of stalked pinnae, each with 1 to 2 pairs of shortly stalked distant leaflets that are entire to deeply divided into ovate-dentate lobes; upper leaves much smaller than those of midstem. Racemes shortly stalked, leaf-opposed, very dense at first, soon elongating, to 10-flowered; bracts rhombic-obovate, obtuse to usually acuminate, with short indistinct stalk, equaling or longer than the pedicels; pedicels 1–2 mm (to 4 mm in fruit), rather thick, slightly arcuate-recurved in fruit. Sepals 1–2 × 1 mm, ovate, dentate; corolla white (?), closed, small, ca. 5 mm, ecalcarate, as if stunted in bud stage, completely cleistogamous; outer petals with narrow dentate crests; stigma transversely oblong with indistinct lateral papillae and 2 apical papillae. Capsule fusiform, ca. 20 × 4 mm, 10- to 15-seeded with seeds in 2 rows, usually crowned at apex by corolla, which soon breaks loose from the pedicel by the quickly growing fruit; seeds ca. 1.75 mm, rounded in outline, not keeled; testa cells convex, set in concentric rows; each testa cell toward back of seed with a low tubercle, but on seed flanks small radial linear grooves between the testa cells dominate the pattern; elaiosome flat and membranous, partly folded back over the seed, easily detaching; hilum broader than long.

Etymology. The epithet is derived from Greek "kryptos" (hidden) and "gamos" (wedding), referring to the closed flowers.

Relationships. Corydalis cryptogama clearly belongs in section *Sophorocapnos* (tap-rooted annual; bracts small, lanceolate, entire; spur obtuse, shorter than limb; stigma transversely set with few and indistinct papillae; fruit nonexplosive; seeds tuberculate with large membranous elaiosome) and is similar to *C. parviflora* Z. Y. Su & Lidén from southeast Yunnan, southwest Guizhou, and east Guangxi. It differs from this species in much more divided leaves, short peduncles (to 1 cm vs. 2–4 cm), broader bracts, and seeds that are produced in two rows (vs. one row). *Corydalis parviflora* has been stated to be perennial (probably mistakenly), whereas the new species is probably annual. A further similarity between them is the production of cleistogamous flowers, but this occurs also in other species of this section (*C.*

balansae Prain, *C. brevipedunculata* (Z. Y. Su) Z. Y. Su & Lidén).

IUCN Red List category. *Corydalis cryptogama* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Section *Chrysocapnos* Wendelbo

3. Corydalis milarepa Lidén & Z. Y. Su, sp. nov. TYPE: China. Xizang: Mi La N of Rutok [92°21′E; 29°49′N], E side, open stony soil, 4850 m, 12 July 2005, *H. Jans & J. Birks 6* (holotype, UPS).

Herba glabra valde glauca verisimiliter perennis; caules ascendenti foliati non ramosi. Folia basalia triangularia subsessilia ternata, foliolis pinnatis segmentis integris vel profunde bi-tri-fidis, lobis integris lanceolatis acutis; folia superiora minora pinnata ovato-oblonga. Racemi densi 10- ad 30-flori; bracteae inferiores subpinnatifidae, superiores parce divisae vel integrae, pedicellos aequantibus, pedicellis stato florifero leviter arcuato-recurvatis. Flos malvinus vel lilacinus, late cristatus, ca. 17 mm longus calcari ca. 8 mm longo inclusus. Capsula ignota.

Probably perennial, glabrous, slightly fleshy, glaucous herb; underground parts unknown; flowering stem ca. 13 cm, unbranched, ascending, with 4 leaves. Lower cauline leaves triangular in outline, subsessile, ternately divided with rather long-stalked primary leaflets, these pinnate with 2 to 3 pairs of entire to bi- or trifid pinnae ca. 10 mm; central primary leaflet 35–40 mm, lateral leaflets 20–25 mm; ultimate leaf segments lanceolate to broadly oblanceolate, acute, 2–4(–5) mm broad, not or slightly overlapping; middle and upper cauline leaves sessile, smaller (ca. 20 mm and ca. 10 mm, respectively, in type), narrowly ovate in outline with basalmost pair of lateral leaflets sessile and short, hardly longer than second pair. Racemes dense, 10- to 30-flowered, up to 4 cm in anthesis; lower bracts subpinnately divided to dentate, with lower lobes often again divided or dentate; upper bracts narrower, less divided or entire; pedicels soon becoming slightly arcuate-recurved, 6–8 mm, equaling bracts. Flowers pale to dark mauve, often more blue toward spur, with keels of outer petals much darker, ca. 17 mm; inner petals whitish at tip (except for the inner, hidden, adaxial side, which has a dark purple blotch like most Fumarioideae); sepals to 1 mm, whitish, apically deeply divided into a few long narrow teeth; outer petals broadly crested, acute at apex, or lower one subobtuse; spur of upper petal ca. 8 mm, slightly curved downward, somewhat tapering toward obtuse tip; nectary ca. 5 mm; inner petals ca. 8 mm; ovary with ca. 7 ovules; stigma almost squarish with 4 apical papillae, and geminate lateral and basal papillae. Fruit and seeds unknown.

Distribution. *Corydalis milarepa* is only known from a single flowering stem and three photos taken by Harry Jans and Hilary Birks in conjunction with the type collection. The species was seen in a few places between 4850 and 5050 m (Birks, 2006).

Etymology. The epithet, an arbitrarily compounded noun in apposition (ICBN Art. 23.1; McNeil et al., 2006), is based on Mi La, the type locality, and "repa," a Tibetan dance with connection to Milarepa, a very important yogi in Tibetan Buddhism, famous for his beautiful songs and his ability to fly.

Relationships. *Corydalis milarepa* is provisionally placed in section *Chrysocapnos*, although the underground parts are unknown, but deviates from other species in this section in its non-yellow flowers. The most similar species is *C. imbricata* Z. Y. Su & Lidén, but our new species has leaves with more spaced and acute leaflets (vs. closely imbricate and obtuse), divided bracts (vs. entire), and mauve flowers (vs. yellow). Furthermore, it is completely smooth, whereas *C. imbricata* has papillose-scabrid margins to leaves and bracts.

IUCN Red List category. *Corydalis milarepa* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Section *Elatae* Fedde ex C. Y. Wu & H. Chuang

Species 4 to 17 all belong in section *Elatae* s.l., characterized by fleshy rhizome with fleshy imbricate scales, apically with axillary stems, blue (rarely purple or white) long-spurred flowers, thin, straight, erectopatent fruiting pedicels, and explosively dehiscent capsules.

4. Corydalis aeditua Lidén & Z. Y. Su, sp. nov. TYPE: China. Sichuan: Omeishan, Xi Xiangchi ["pool of washing elephant," famous temple], 28 June 1976, *s. coll. 1678* (holotype, PE).

Herba perennis; rhizoma squamis crassis, radicibus subcrassis elongatis; caulis gracilis foliatus non vel parce ramosus. Folia radicalia pauca parva petiolata ternata profunde lobata, lobis obovatis; folia caulina 3 ad 4, brevipetiolata vel subsessilia ternata ad biternata, foliolis obtriangularibus basi cuneatis apice profunde crenatodentatis vel parum lobatis, lobis obtusis oblongis. Racemi breves densi, ca. 10-flori; bracteae late spatulatae sub-integrae, pedicellis 7–10 mm longis gracilibus breviores. Sepala rotundata profunde dentata; corolla azurea (?); petala exteriora anguste cristata apicem versus late obovato-rotundata mucronata; petalum superum calcari 11–13 mm longo attenuato non curvato. Capsula ignota.

Rhizome with fleshy scales and few rather thick roots; stems slender, ascending, ca. 35 cm, with 3 or 4 shortly stalked small leaves along upper half, un-

branched or with a flowering branch from axil of uppermost leaf. Leaves glaucous abaxially, green adaxially; radical leaves few, with small ternate lamina, ca. 2 × 2–3 cm, with leaflets deeply lobed into obovate segments; petiole 10–12 cm; cauline leaves like radical; lowermost cauline leaf sometimes long stalked; upper cauline leaves shortly stalked to subsessile; lamina ternate to biternate with obtriangular leaflets with cuneate base, apically grossly crenate-dentate to shallowly lobed into oblong obtuse segments 2–5 mm wide. Raceme short and dense, ca. 10-flowered; bracts broadly spatulate, obtuse, often with a few small lateral teeth, ca. 5 mm; pedicels 7–10 mm at anthesis, probably erect. Sepals rounded, 2–2.5 × 2 mm, profoundly dentate; corolla given as blue on label (*s. coll. 1678*, PE) appears to be purplish blue at apex with blue spur and pale blue dorsal wings to inner petals; outer petals narrowly crested with broad mucronate apices; spur of upper petal straight, tapering to a narrow apex, 11–13 mm, with a thin nectary reaching 2/3 through spur; lower petal 12–13 mm, with a short claw widened into a broad rounded apically mucronate erose-dentate limb; inner petals ca. 11 mm, with dorsal wings slightly projecting beyond apex; ovary linear with 11 to 12 ovules, tipped by a ca. 3 mm style; style conspicuously swollen and flexible where stigma attaches. Fruit unknown.

Etymology. The epithet "aeditua," which is Latin for temple guardian, is treated as a noun in apposition.

Relationships. *Corydalis aeditua* is closely related to *C. omeiana* (C. Y. Wu & H. Chuang) Z. Y. Su & Lidén (Ree, Wang & Lidén, unpublished data), which is a common species higher up on Omei shan, but our new species differs in the crested outer petals, much dentate lower petal limb, thin sepals, rather different foliage, and a very different ecology.

IUCN Red List category. *Corydalis aeditua* should be classified as VU (Vulnerable) according to IUCN criteria (IUCN, 2001). The species has only been collected twice, possibly in the same spot. Only four individuals were seen in 2006. It should be noted that the search was made after the plant had withered, and so it could have been easily overlooked and is probably more common than this number suggests. However, it is quite possible that this is the only locality.

Paratypes. CHINA. **Sichuan:** Omei shan, below Xi Xiangchi, 1600 m, almost vertical very wet cliff above stream, 11 Aug. 2006, *Lidén & Yu S.-X. 72* (fragment at UPS).

5. Corydalis gymnopoda Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan: Jinchuan [Dajin], Kasa, Banbian shan, in forest, 3800 m, 23 June 1958, *Xing Li 77854* (holotype, PE).

Caules debiles, inferne nudi, superne 2-foliati, non ramosi. Folia radicalia longepetiolata ternata, foliolis breviter petiolulatis in lobis late obovatis subacutis divisis; folia caulina sessilia, parva, radicalibus similia. Racemi densissimi 6- ad 10-flori; bracteae integrae obovatae subacutae, pedicellos subaequantes vel paulo longiores. Corolla azurea cristata calcari subrecto obtuso.

A *Corydale pseudobarbisepala* Fedde caule solum in triente supera foliato et floribus multo minoribus differt.

Rhizome probably short and with rather few fleshy scales; stems simple, rather slender, 16–23 cm, naked below, with 2 leaves in upper 1/3. Radical leaves long stalked with petiole 9–16 cm; lamina ca. 3 × 4 cm, ternately divided with stalked leaflets ± deeply cut into broadly obovate subacute lobes that are often again shallowly 3-lobed at apex; cauline leaves like radical but sessile and usually smaller, up to 2 cm; upper leaf set shortly below inflorescence, smaller and less divided. Raceme very dense, 6- to 10-flowered; bracts obovate-subacute, 6–10 mm, entire; pedicels 5–8 mm. Corolla blue, darker at apex; outer petals with 1–2 mm broad crest attenuate toward apex; spur ca. 9 mm, obtuse; inner petals ca. 8 mm. Fruit unknown.

Etymology. The epithet is based on Greek "gymnos" (naked) and "podus" (foot), referring to the basally leafless stem.

Relationships. *Corydalis gymnopoda* is similar to *C. pseudobarbisepala*, but differs in much smaller flowers and absence of leaves in the lower half of the stem. The type specimen was originally determined as *C. pingwuensis* C. Y. Wu, but this species has stems leafy throughout, more divided leaves with narrower leaf lobes, laxer racemes, and much narrower flowers.

IUCN Red List category. *Corydalis gymnopoda* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

6. Corydalis harry-smithii Lidén & Z. Y. Su, nom. et stat. nov. Replaced name: *Corydalis elata* subsp. *ecristata* C. Y. Wu, Flora Reipubl. Popularis Sin. 32: 544. 1999. TYPE: China. Sichuan: Kangding, Yülingkong, in prato herboso-fruticoso, 3100 m, 22 July 1934, *H. Smith 10748* (holotype, S; isotype, UPS).

Rhizome short, with fleshy scales that become dark on drying, terminating in a small rosette of leaves; stems 1 to 4, 35–60 cm, erect to ascending, sparingly leafy from middle upward, branched. Radical leaves long stalked; petiole 10–22 cm; lamina glaucous

abaxially, green adaxially, 4–7 × 5–10 cm, ternate to biternate with leaflets shallowly to deeply divided into obovate entire to divided lobes; ultimate lobes (1–) 2–15 mm broad, obtuse; cauline leaves smaller, shortly stalked, less divided. Racemes 10- to 32-flowered (much less in late axillary racemes); bracts 6–15 mm; upper bracts linear to narrowly oblanceolate, entire to slightly dentate; lowermost bracts usually larger and divided, or similar to uppermost leaves; pedicels thin, suberect in fruit, 10–20(–30) mm. Sepals narrowly ovate-acute, to 1 mm, with few small teeth; outer petals ecristate, sky blue; spur of upper petal 8–12 mm, straight or slightly curved downward, slightly tapering toward apex, with very thin, almost invisible nectary reaching 2/3 through spur; lower petal 12–13 mm, with rhombic acute to slightly acuminate obtusely dentate limb attenuate to shallowly gibbous claw; inner petals 10–11 mm, with pale claw about half as long; dorsal crests of inner petals with a clear blue portion subapically, but white at the very tip; apical internal (adaxial) side of inner petals with a prominent dark purple blotch. Capsule pendent from erectopatent pedicel, obovate to elliptic, 2- to 9-seeded, ca. 10 × 3–4 mm, tipped by sharply set off ca. 5 mm style. Seeds smooth, ca. 2 mm, with prominent uneven elaiosome.

Distribution and phenology. *Corydalis harry-smithii* grows west and southwest of Kangding (Sichuan), at 3100–3800 m, in the shade of trees or shrubs in moist soil close to running water. Flowering in July, fruiting August.

Etymology. The epithet commemorates Dr. Harry Smith from Uppsala, who collected extensively in Sichuan during three expeditions from 1923 to 1934. It is to be noted that "*ecristata*" is not available as a specific epithet in *Corydalis* due to the presence of *C. ecristata* (Prain) D. G. Long.

Relationships. *Corydalis harry-smithii* is closely related to *C. elata* Bureau & Franchet, but differs in many-flowered racemes of smaller, thin-spurred flowers that are never crested and have a rudimentary nectary.

IUCN Red List category. *Corydalis harry-smithii* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). The species was recently collected in two different localities picked at random during the Lidén and Wang 2005 expedition.

Selected specimens examined. CHINA. **Sichuan:** Kangding, Cheto La, 4 Aug. 1934, *H. Smith 10930* (UPS); E Cheto La, 14 Aug. 2005, *Wang Y.-W. & M. Lidén 48* (PE); Kangding, S Yulingkong toward Gonga shan area, N of pass, 15 Aug. 2005, *Wang Y.-W. & M. Lidén 53* (PE, UPS); Kangding, 1924, *Cunningham 451* (E); S of Kangding, Yulong-Hsi, Minya country, July 1929, *J. Rock 17579a* (A).

7. Corydalis lagochila Lidén & Z. Y. Su, sp. nov. TYPE: China. Sichuan: Baoxing, under forest, 3200 m, 14 June 1958 (fl), [*Tzu-pu Soong*] *Zhang X.-B. & Ren Y.-X. 5393* (holotype, PE; isotype, SZ).

Herba glabra perennis; caules humiles 1(ad 2)-foliati non ramosi. Folia radicalia parva petiolata ternata vel subbiternata profunde lobata, lobis obovatis; folium caulinum brevipetiolatum ternatum, foliolis sessilibus profunde 2 vel 3 divisis, segmentis plus minusve partitis, lobis obovatis. Racemi corymbosi, 6- ad 7-flori; bracteae integrae late obovatae obtusae basin cuneatae; bractea ima major basi lobis lateralis parvis; pedicelli bracteis duplo longiores. Sepala parva dentata; corolla azurea; petalum superum apice profunde emarginatum breviter et anguste cristatum, calcari brevi late oblongo; petalum inferum limbo late rotundato emarginato; ovarium lineare pluriovulatum. Capsula ignota.

A *Corydale mucronipetala* (H. Chuang) Lidén & Z. Y. Su caulibus paucifoliatis petalis profunde emarginatis differt.

Glabrous perennial herb; rhizome short (?) with small fleshy scales; stems 11–15 cm, unbranched or with a late very small branch, with 1 or 2 leaves in upper half of stem. Radical leaves several, with 2–5 cm petiole; lamina triangular in outline, ca. 1.5–2.5 × 2–3 cm, ternate to biternate with rather deeply divided leaflets sometimes again shallowly divided apically; cauline leaf with short petiole, 5–10 mm, lamina rounded in outline, ca. 2 × 2 cm, ternately divided with leaflets deeply cut into 2 to 3 obovate lobes that may again be shallowly divided; if second cauline leaf present, similar to lowermost bract. Racemes corymbose, 6- to 7-flowered; bracts broadly obovate, 6–11 mm; lower one larger and with small lateral lobes; pedicels 12–22 mm, or upper ones shorter. Sepals rounded, ca. 1 mm, finely dentate; corolla blue, probably with a purplish hue (in sched., *Zhang X.-B. & Ren Y.-X. 5393*, PE); outer petals with short and low subapical slightly dentate crests; upper petal deeply emarginate at apex, with rounded divisions and a very broad and short spur, 10–11 × 4 mm, not tapering toward obtuse apex; nectary 4–5 mm; lower petal 17–18 mm, with distinct claw and wide emarginate limb, 8–10 mm broad. Ovary linear with 42 ovules.

Etymology. The epithet is based on Greek "lago-" (pertaining to hare) and "chilos" (lip), referring to the shape of the limbs of the outer petals.

Relationships. *Corydalis lagochila* is closely related to *C. mucronipetala*, but distinguished by few leaves (usually 1 vs. 4 or 5), a broader corolla with much smaller crests and shorter spur, and above all by the deeply emarginate (vs. conspicuously mucronate) outer petals.

IUCN Red List category. *Corydalis lagochila* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

8. Corydalis madida Lidén & Z. Y. Su, sp. nov. TYPE: China. Sichuan: Wenchuan, Woolong, Yingchanggou, in seepage on NE-facing almost vertical soft rocks with a slimy cover of bacteria and cyanophytes, 2100 m, 8 Aug. 2005, *Wang Y.-W. & M. Lidén 1* (holotype, PE; isotypes, KUN, MO, UPS).

Herba perennis; rhizoma horizontale squamis crassis dense disticho-imbricatis; caules foliati ramosi rubescentes minutissime pubescentes. Folia intense glauca, radicalia petiolata biternata, foliolis late obovatis; folia caulina radicalibus similia sed minora. Racemi densi, 10- ad 23-flori, in statu fructifero elongati; bracteae inferiores late obovatae vel rotundatae parce divisae basi cuneatae interdum brevissime petiolatae, pedicellis 8–20 mm longis gracilibus breviores; bracteae superiores minores, saepe late lanceolatae integrae. Sepala rotundata dentata; corolla ecristata subacuta eburnea, apicem versus albo-viridis, calcari 16–18 mm longo gracili leviter curvato vel subsigmoideo. Capsula anguste fusiformis polysperma, ex pedicello stricto pendula.

Rhizome horizontal, 1–6 cm, densely clothed with imbricate thick fleshy reddish scales, apparently in 2 rows; stems few to several, 15–40 cm tall, reddish in fresh state, leafy, branched, finely papillose pubescent below. Leaves very glaucous on both sides, especially abaxially; lamina biternatisect to subbipinnatisect; leaflets obovate, shallowly to deeply cut into obovate obtuse ultimate lobes; uppermost leaves (and leaves of shorter stems) less divided, grading into bracts. Racemes very dense at anthesis, soon elongating, 10- to 23-flowered; lower bracts rounded in outline, shallowly cut into few obtuse lobes, middle and upper bracts entire, broadly obovate, attenuate at base, shorter than the 8–20 mm straight erectopatent thin pedicels. Sepals rounded, ca. 1.5 × 2 mm, finely dentate; corolla creamy white, sometimes with faint pinkish tint toward spur, pale yellowish green toward apex; dorsal crests of inner petals white; inner side of apex of inner petals dark red (not visible from outside); after pollination with muddy purplish hue and apex of inner petals becoming darker; outer petals ecristate; spur of upper petal narrow, attenuate toward tip, slightly sigmoidally curved, more strongly curved downward in bud stage, 16–18 mm; nectary 1/2–2/3 as long; inner petals 14–15 mm, including 10 mm claw; lower petal ca. 15 mm, straight with long narrow claw gradually dilated into rhombic-acute, sometimes shallowly 3-lobed limb; stigma with pronounced basal lobes. Capsule reddish when fresh, sharply pendent from straight pedicel, narrowly fusiform, 4- to 15-seeded (ovary with up to 18 ovules), 13–15 × 2–3 mm, gradually attenuate into ca. 4 mm long straight style. Seeds small (ca. 1.5 mm) with small elaiosomes.

Distribution and phenology. *Corydalis madida* is only known from two small colonies on vertical cliffs along tributaries to the Woolong river. A third locality for this species (valley of heroes, 2500 m, 23 July 2001), in the Woolong valley, has been recorded by John Birks, Bergen, Norway, and verified by photographs. Flowering in July and August, fruiting August.

Etymology. The epithet is derived from Latin "madidus" (watered), referring to the wet habitat of this species.

IUCN Red List category. *Corydalis madida* should be classified as VU (Vulnerable) according to IUCN criteria (IUCN, 2001). The species is known from two localities, both very restricted and poor in individuals (probably < 100), and commercial collection could easily wipe out a whole population.

Paratype. CHINA. **Sichuan:** Wenchuan, Woolong valley, 2100–2300 m, *s. coll. 1238* (KUN).

9. Corydalis microflora (H. Chuang) Z. Y. Su & Lidén, stat. nov. Basionym: *Corydalis flexuosa* Franchet var. *microflora* H. Chuang, Acta Bot. Yunnan. 13: 132. 1991. *Corydalis flexuosa.* subsp. *microflora* (H. Chuang) C. Y. Wu, Flora Reipubl. Popularis Sin. 32: 118. 1999. TYPE: China. Sichuan: Shih-mien, 2480 m, 20 June 1955, *Xie Z.-J. [Hsieh C.-C.] 41235* (holotype, PE; isotype, SM).

Rhizome short (or cut short at collecting) with small crowded fleshy scales; stems slender, erect, simple, 25–35 cm, naked in lower 2/3, above with 1 to 2 leaves. Radical leaves (only one seen) with thin petiole, ca. 9 cm; lamina glaucous abaxially, biternate, ca. 3 × 3 cm, leaflets obovate, entire (terminal one shallowly 3-lobed); cauline leaves shortly stalked to subsessile, biternate, 3–5 × 3–4 cm; petiolule of lateral primary leaflets ca. 5 mm; petiolule of terminal leaflet 10–15 mm; secondary leaflets 8–15 mm, broadly obovate, ± deeply divided into broad rounded lobes. Racemes lax, 5- to 7-flowered, only slightly elongating in fruit; lower bracts like cauline leaves, upper bracts progressively smaller and less divided; pedicels 6–10 mm in flower; fruiting pedicels suberect to patent, 10–15 mm. Sepals to 1 × 1 mm, grossly dentate; corolla ca. 20 mm, probably blue or pale purple; outer petals acute; spur of upper petal ca. 10 mm, narrowly cylindric, straight or slightly curved downward; inner petals ca. 10 mm; stigma rounded at base (no basal protrusions). Capsule 5- to 13-seeded, linear, 15–20 mm, including ca. 2.5 mm long style.

Relationships. *Corydalis microflora* is odd in section *Elatae* in its biternate bracts with stalked rounded leaflets and peculiar stigma. The original epithet is maintained here, although there are other members in the section *Elatae* with equally small or even smaller flowers (e.g., *C. gymnopoda* Z. Y. Su & Lidén, *C. pingwuensis* C. Y. Wu).

IUCN Red List category. *Corydalis microflora* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

10. Corydalis mucronipetala (H. Chuang) Lidén & Z. Y. Su, stat. nov. Basionym: *Corydalis flexuosa* var. *mucronipetala* C. Y. Wu & H. Chuang, Acta Bot. Yunnan. 13: 132. 1991. *Corydalis flexuosa* subsp. *mucronipetala* (C. Y. Wu & H. Chuang) C. Y. Wu, Flora Reipubl. Popularis Sin. 32: 118. 1999. TYPE: China. Sichuan: Tianquan, 3340 m, *Chu K.-L. 2806* (holotype, PE; isotypes, E, P, SZ).

Relationships. Although possibly related to *Corydalis flexuosa* Franchet (based on the linear capsules), *C. mucronipetala* deviates considerably in a number of characters. The stems are much shorter (10–25 cm vs. 25–40 cm), the outer petals are broadly crested (vs. ecristate) and conspicuously mucronate (vs. upper petal acute, lower petal obtuse), the spur is thicker and shorter, and the ovary has twice as many ovules (i.e., up to 40). The habitats are also widely different; *C. mucronipetala* grows in screes and seasonally flooded bouldery riverbeds, and *C. flexuosa* grows in humid stable situations in open forests or on wet cliffs. *C. mucronipetala* is closely related to *C. lagochila* Lidén & Z. Y. Su. For a discussion, see that species.

IUCN Red List category. *Corydalis mucronipetala* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001).

11. Corydalis omeiana (C. Y. Wu & H. Chuang) Z. Y. Su & Lidén, stat. nov. Basionym: *Corydalis flexuosa* var. *omeiana* C. Y. Wu & H. Chuang, Acta Bot. Yunnan. 13: 131. 1991. *Corydalis flexuosa* subsp. *omeiana* (C. Y. Wu & H. Chuang) C. Y. Wu, Flora Reipubl. Popularis Sin. 32: 118. 1999. TYPE: China. Sichuan: Omei shan, s.d., *Chen S.-Y. 3908* (holotype, SM, photo, KUN).

Distribution and relationships. *Corydalis omeiana* is common on Omeishan between 2500 and 3000 m, often growing together with *C. davidii* Franchet in disturbed glades, along roadsides, and in clearings, but also in rather shady sites in forests. It was introduced into the horticultural trade several years ago as *C. elata*. It has a habitual likeness to *C. flexuosa*, explaining why it was first attributed to that species, but the elliptic few-seeded fruit (vs. linear many-seeded fruit) and broad claw to the lower petal (vs. claw linear in *C. flexuosa*) point to a closer relationship with *C. elata*. It deviates from *C. elata* in the leaves that are glaucous only abaxially, the shortly stalked and much smaller radical leaves, the dense racemes, and the large uneven early-falling sepals.

IUCN Red List category. *Corydalis omeiana* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). The species is common on Omeishan, and even seems to benefit from the current heavy human disturbance.

12. Corydalis papillosa Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan: Mianning, 4200 m, 30 June 1978, *Sichuan med. plant Mianning exp. 0305* (holotype, SM).

Herba perennis ubique minutissime dense papilloso-pubescens; rhizoma breve squamis paucis crassis imbricatis, radicibus subcrassis elongatis; caules 15–19 cm longi inferne nudi, superne 1- ad 2-foliati, non ramosi. Folia radicalia 4 ad 6, ternata usque quinata, foliolis obovatis profunde bi vel tri-lobatis, lobis anguste oblongis obtusis; folia caulina sessilia profunde divisa, lobis anguste lineari-oblongis. Racemi subsecundi 6- ad 13-flori; bracteae parvae anguste oblanceo-latae sub-integrae vel bracteae inferiores parce divisae, pedicellos 6–14 mm longos graciles aequantes vel iis breviores. Sepala minuta dentata; corolla ecristata acuta, calcari 10 mm longo recto obtuso. Capsula ignota.

Whole plant finely and densely papillose-pubescent; stems few, unbranched, 15–19 cm, from short rhizome with long wiry roots. Radical leaves 4 to 6; petiole 4–7 cm; lamina divided to base into 3 to 5 sessile 15–20 mm deeply divided obovate leaflets; ultimate lobes oblong, 2–3 mm wide, obtuse; cauline leaves 1 to 2 in upper half of stem, sessile, deeply and irregularly divided into ca. 5 narrow lobes. Racemes shortly stalked, subsecund (?), 6- to 13-flowered, rather lax; bracts small, narrowly oblanceolate, 5–7 mm, or lowermost larger and divided; pedicels 6–14 mm, not known in fruiting stage. Sepals ca. 0.5 × 1 mm, dentate; corolla purplish green (appears blue in dry state), ecristate, subacute at apex; spur of upper petal straight, hardly tapering to obtuse apex, ca. 10 mm, with nectary reaching less than halfway; lower petal ca. 12 mm, with short claw gradually widened into rhombic slightly sinuate-dentate acute limb, and with small gibbosity close to base.

Etymology. The epithet *papillosa*, meaning "covered with papillae," is based on Latin "papilla" (nipple) and "-osus" (suffix meaning "full of"), and refers to the fine papillose pubescence of this plant.

Relationships. The lower petal reaches conspicuously more forward than its upper counterpart, giving the flower a distinctive profile. *Corydalis papillosa* seems rather isolated in the section *Elatae*, but is possibly related to a group comprising, e.g., *C. pingwuensis*, *C. rorida* H. Chuang, *C. gymnopoda*, and *C. panda* Lidén & Y. W. Wang.

IUCN Red List category. *Corydalis papillosa* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

13. Corydalis procera Lidén & Z. Y. Su, sp. nov. TYPE: China. Sichuan: W Sichuan, July 1908, *E. Wilson 2295* (holotype, K).

Herba perennis; rhizoma horizontale breve, squamis crassis dense imbricatis; caules graciles 60 cm longi superne 3- ad 4-foliati, non vel parce ramosi. Folia radicalia pauca parva bi-tri-ternata petiolata, lobis anguste oblongis; folia caulina parva subsessilia radicalibus similia. Racemi densi 15- ad 17-flori; bracteae parvae anguste lanceolatae subintegrae, pedicellis 7–9 mm longis gracilibus breviores. Sepala minutissima; corolla ecristata subacuta pallida, calcari longo non vel leviter curvato. Capsula ignota.

Perennial herb; rhizome short, thick, densely clothed with fleshy scales, becoming a black and hard bulblike structure in herbarium specimens; stems unbranched or with 1 late branch, slender, to 60 cm, with 3 to 4 small leaves scattered in upper half of stem. Radical leaves few, small, in basal rosette; petioles 5–6 cm, lamina ca. 5 × 5 cm, bi- to triternate, ultimate lobes narrowly oblong, ca. 2 mm broad; cauline leaves like radical, but shortly stalked or sessile. Racemes short (fruiting stage not known), 15- to 17-flowered; bracts small, ca. 5 mm, narrowly lanceolate with the occasional narrow tooth or lobe (lowermost bract in one raceme of type specimen large and similar to uppermost leaf); pedicels thin, 7–9 mm. Sepals to 0.5 mm; corolla ecristate, apparently white or at least pale, subacute at apex; spur of upper petal 15–16 mm, slightly attenuate, almost straight to slightly bent downward; nectary reaching almost halfway through spur; lower petal ca. 12 mm, straight; inner petals 11–12 mm; ovary with 6 to 7 ovules and 4 mm style. Capsule unknown.

Etymology. The Latin epithet "procerus" (tall) "is said of plants which are taller than their parts would have led one to expect" (Stearn, 1992: 330).

Relationships. *Corydalis procera* is possibly related to *C. flexuosa*, and the type was so determined by Prof. Wu Cheng-Yih, but it is readily distinguished by its shorter pedicels (7–9 mm vs. 15–20 mm), fewer ovules (6 to 7 vs. 15 to 23), and comparatively longer spur (clearly longer than limb vs. shorter than to equaling limb).

IUCN Red List category. *Corydalis procera* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

14. Corydalis pseudomairei C. Y. Wu ex Z. Y. Su & Lidén, nom. et stat. nov. Replaced name: *Corydalis mairei* var. *megalantha* C. Y. Wu, Acta Bot. Yunnan. 13: 138. 1991. TYPE: China. Sichuan: Leibo, Huang-mao-geng, 2900 m, wet places in dense forest, 19 June 1959 (fl), *Sich. Econ. Pl. Exp. (SEPE) Liang 0766* (holotype, KUN; isotype, PE).

Distribution and phenology. *Corydalis pseudomairei* grows in southern Sichuan at 2400–3600 m on shady, wet, forested hill slopes. Flowering in May to July, fruiting July to August.

Etymology. The epithet was suggested by Prof. Wu Cheng-Yih (in sched., *Sich. Econ. Pl. Exp. (SEPE) Liang 0766*, KUN; pers. comm.) based on Greek "pseudo-" (prefix meaning "false"), referring to the similarity of this species to *Corydalis mairei* H. Léveillé.

Relationships. *Corydalis pseudomairei* is clearly distinct from *C. mairei* in the stem (sparingly leafy only above with few spreading branches vs. leafy throughout with numerous erect strict branches), the lower bracts (3–5 cm vs. 1–2 cm), the very long pedicels to the lower flowers (25–35 mm vs. 10–20 mm), and the larger flowers (26–30 mm vs. 21–24 mm).

IUCN Red List category. *Corydalis pseudomairei* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Selected specimens examined. CHINA. **Sichuan:** Butuo, Bushi, Wu-ke-mu-chang, Luo-gu-ri-ze, 16 July 1976, *Sichuan Pl. Coll. 13800* (CDBI, PE); Leibo, 9 Sep. 1983, *s. coll. 118119* (PE, SM, SZ); Liangshan, Leibo, Wenshui district, Panjia shan, 17 May 1959, *Sichuan econ. pl. exp (SEPE) 0161* (PE); Leibo, *Sichuan econ. pl. exp (SEPE) Liang 0832* (KUN).

15. Corydalis sarcolepis Lidén & Z. Y. Su, sp. nov. TYPE: China. Sichuan: W Sichuan, 2435 m, May 1904 (fl), *E. Wilson 3179* (holotype, K; isotype, P).

Herba perennis glabra; rhizoma horizontale squamis crassis dense imbricatis; caules simplices, superne parce foliati. Folia radicalia biternata longe petiolata, foliolis profunde divisis lobis angustis; folia caulina radicalibus similia sed minora, petiolis multo brevioribus. Racemi breves, 5- ad 11-flori, in statu fructifero parce elongati; bracteae inferiores profunde divisae, lobis angustis acutis interdum acuminatis petiolos subaequantes; bracteae superiores minores parce divisae; pedicelli suberecti 15–20 mm longi. Sepala parva dentata; corolla purpurea vel rosea

ecristata obtusa, calcari brevi crasso stricto vel leviter curvato apice rotundato. Capsula pachyderma obovato-obtusa ex pedicello stricto pendula.

Perennial glabrous herb; rhizome horizontal, densely clothed with thick fleshy scales; stems 30–40 cm, sparingly leafy in upper half, unbranched. Radical leaves few (2 to 4), 18–25 cm including petiole, 10–17 cm; lamina triangular in outline, 6–9 × 6–9 cm, biternate with leaflets deeply cut into narrowly oblong lobes; cauline leaves 2 to 4, like radical leaves but smaller and upper ones shortly stalked. Racemes 5- to 11-flowered, dense in anthesis, slightly elongating in fruit; lower bracts much divided into narrow acute or acuminate lobes, progressively smaller upward; uppermost ones occasionally entire; pedicels 15–20 mm, suberect, only slightly elongating in fruit, equaling or usually longer than bracts. Sepals 1–2 × 1–2 mm, finely dentate; corolla purple (type specimen) to pale red (*Veg. Team 41623*, CDBI), ± at right angle to pedicel; upper petal ecristate, broadly obtuse, with thick straight or slightly curved obtuse spur ca. 15 mm; nectary about half as long; lower petal ca. 20 mm, ecristate, straight, spatulate, with broadly obtuse limb; inner petals 15–17 mm including claw, ca. 10 mm. Capsule obovate with narrow base and broadly obtuse apex, pendent from erect pedicels, 10–12 × 4 mm, tipped by ca. 4 mm sharply set off style; capsule valves thick; seeds 10 to 16.

Distribution and phenology. *Corydalis sarcolepis* grows in forests and forest margins at 2200–2450 m, and is known from the surroundings of Moxi south of Kangding and Luding in the east Gongkashan area in Sichuan province. Flowering in April, fruiting May.

Etymology. The epithet is derived from Greek "sarx" (flesh) and "lepis" (scale), referring to the fleshy scales on the rhizome.

Relationships. *Corydalis sarcolepis* belongs in a group of three species. It can be distinguished from *C. weigoldii* Fedde (Sichuan: Wawushan) and *C. caput-medusae* Z. Y. Su & Lidén (northeast Yunnan) by the much broader, short-spurred flowers and the short broad fruit. A fourth taxon described in this group, *C. crassirhizomata* (C. Y. Wu) C. Y. Wu (Sichuan: Mianning), deviates from *C. weigoldii* only by broader leaf lobes.

IUCN Red List category. *Corydalis sarcolepis* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Paratypes. CHINA. **Sichuan:** Kangding, *A. E. Pratt 822* (K); Luding, Moxi, Gonghe, Hai-luo-gou, Da-wan-zi, 23 Apr. 1981, *s. coll. 25117* (CDBI); Moxi, Hai-luo-gou, Shi-ban, 23 May 1981, *s. coll. 25368* (CDBI); Moxi, Gonghe, Gonghesi-dui, Xiaogou, Apr. 1982, *Veg. Team 41623* (CDBI).

16. Corydalis virginea Lidén & Z. Y. Su, sp. nov. TYPE: China. Shaanxi: Chang'an, Ziwu xiang, Dongfang gou, humid slope, 2500 m, 7 June 1960, *NW China University Chang'an exped. 0050* (holotype, PE).

Herba glabra perennis; caulis non ramosus gracilis inferne nudus superne 5- vel 6-foliatus. Folia radicalia ignota; folia caulina sessilia obovata bi-tri-jugo-pinnata, foliolis basalibus parvis stipuliformibus; foliola obtriangularia cuneata apice profunde crenatodentata vel parum lobata. Racemi 12- ad 14-flori; bracteae oblanceolatae sub-integrae, pedicellis (ca. 10 mm longis gracilibus) breviores. Sepala magna rotundata fimbriata; petala exteriora late et breviter cristata; petalum superum calcari ca. 9 mm longo anguste oblongo vix attenuato substricto. Capsula immatura fusiformis.

Rhizome short with few small fleshy scales; flowering stems (2 stems seen) to 45 cm, unbranched, slender, naked below or with a long-stalked withered leaf close to base, in upper half with 6 to 7 leaves. Radical leaves unknown; cauline leaves green adaxially, glaucous abaxially, obovate in outline, sessile, pinnate with 1 to 2 pairs of leaflets and a large terminal pinna; basalmost pair of leaflets distant from next pair of leaflets, rather small, stipule-like; leaflets flabellate, entire or ± divided into 2 to 3 divisions, apically conspicuously crenate-dentate; uppermost leaves small and simple, ± lobed, serrate-dentate, grading into lowermost bracts; all leaves producing an axillary dark bulbil, as in *Corydalis schweriniana* and *C. bulbilligera*. Racemes subspicate, 12- to 14-flowered; lower bracts broadly oblanceolate with a few sharp teeth; upper bracts often entire; pedicels thin, straight, erectopatent, ca. 10 mm, equaling bracts. Flowers purple; sepals rounded, ca. 4 × 4 mm, lacerate-dentate; outer petals with short and broad rounded crests; spur narrowly oblong, slightly tapering, almost straight or slightly curved upward, ca. 9 mm, with nectary 3/5 as long; inner petals ca. 7 mm. Immature capsule fusiform, ca. 8 mm, tipped by a ca. 2.5 mm style.

Etymology. The epithet is derived from the Latin "virgo" (virgin), referring to the asexual reproduction by bulbils.

Relationships. *Corydalis virginea* has unbranched slender stems with bulbils in all the several leaf axils, as has *C. schweriniana* Fedde and *C. bulbilligera* C. Y. Wu (series *Schweriniana*e C. Y. Wu & H. Chuang), but the conspicuous stipuliform basal pair of leaflets and the large fringed sepals are unique for *C. virginea*.

IUCN Red List category. *Corydalis virginea* should be classified as VU (Vulnerable) according to IUCN criteria (IUCN, 2001). The species has only

been collected once, and the area is known to be subject to heavy recent exploitation.

17. Corydalis yaoi Lidén & Z. Y. Su, sp. nov. TYPE: China. Sichuan: Ebian [Obian], Washan, 16 July 1939, *Yao Z.-W. 4230* (holotype, PE; isotype, SZ).

Herba perennis glabra; rhizoma squamis crassis; caules simplices, superne 1- ad 2-foliati. Folia radicalia longissime petiolata ternata subtus glaucissima, foliolis profunde divisis, lobis late obovatis obtusis; folia caulina (sub-)sessilia, radicalibus similia sed minora. Racemi laxi, ca. 10-flori; bracteae infimae folia caulina simulantes, superiores multo minores angustiores non vel parce divisae; pedicelli suberecti 12–32 mm longi. Sepala parva profunde dentata; corolla 25–28 mm longa purpurea non vel minime cristata subacuminata, calcari oblongo substricto 12–15 mm longo; ovarium anguste oblanceolatum 15-ovulatum; stylus ca. 5 mm longus. Capsula ignota.

Rhizome with large fleshy imbricate scales; stems slender, 33–50 cm, unbranched with 1 to 2 leaves in upper 1/3. Radical leaves few, very long stalked (petiole 17–30 cm) with ternately divided lamina, 3–4 × 4–5 cm, very glaucous abaxially, darker green adaxially, apparently slightly fleshy; leaflets shortly stalked (petiolule of median leaflet 9–12 mm, lateral 2–3 mm), divided almost to base into 2 to 3 broadly obovate lobes again cut to ca. 1/3 into 2 to 3 rounded lobules 3–7 mm broad; lowermost cauline leaf (present on 1 of 3 stems only) like radical leaves but with shorter petiole; upper cauline leaves like radical leaves, but (sub)sessile and slightly smaller. Racemes very lax, ca. 10-flowered; lower bracts similar to cauline leaves, but smaller and less divided; upper ones much smaller, narrower and less divided to entire, shorter than pedicels, 5–10 mm, decreasing in size upward; lowermost pedicel up to 32 mm, upper ones much shorter, at least in flowering stage, 10–15 mm. Sepals small, ca. 1 × 1.5 mm, deeply divided; corolla 25–28 mm, purplish blue, darker toward apical keels of outer petals; outer petals acute to shortly acuminate at apex, without or with very narrow crest; spur of upper petal almost straight, hardly tapering, 12–15 mm, with nectary ca. 2/3 as long; lower petal usually more acuminate at apex than upper one, and with a pronounced sac-like widening sub-basally; inner petals 13–14 mm; ovary narrowly oblanceolate with 15 ovules, tipped by ca. 5 mm style. Capsule not seen; judging from position of ovules in ovarium seeds will be in 2 rows.

Distribution and phenology. *Corydalis yaoi* is found in central Sichuan (Luding: Moxi; Ebian: Washan) at 3400 m. Flowering in June and July.

Etymology. The specific epithet honors Yao Z.-W., who collected the type specimen.

Relationships. *Corydalis yaoi* is related to *C. schusteriana* Fedde, but the rhizome with its imbricate fleshy scales is not quite as tight and columnar; the radical leaves are smaller (ca. 4 cm vs. ca. 10 cm), are less divided (ternate vs. biternate with deeply divided leaflets), and have longer petioles (17–30 cm vs. 11–15 cm); the racemes are laxer with fewer flowers; the bracts are much broader (in *C. schusteriana* narrowly oblanceolate); the sepals are broader and more divided; and the corolla is larger with a wide gibbosity on the lower petal (straight in *C. schusteriana*).

IUCN Red List category. *Corydalis yaoi* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Paratype. CHINA. **Sichuan:** Luding, Moxi Gongshe, Hailuogou, Qiang-huo-peng, "under *Rhododendron*," 3400 m, 18 June 1980, *Wang F.-Q. & Liu Z. 22424* (SM).

Section *Linstowianae* C. Y. Wu & Z. Y. Su

18. Corydalis amplisepala Z. Y. Su & Lidén, nom. et stat. nov. Replaced name: *Corydalis pseudomucronata* var. *cristata* C. Y. Wu, Acta Bot. Yunnan. 18: 401. 1996. TYPE: China. Sichuan: Guang-yuan, Shi-men, beside wet furrows under hill forest, 1800 m, 9 May 1959 (fl, fr), *Sichuan Economic Pl. Exp. (SEPE) Mian 4018* (holotype, CDBI; isotype, KUN).

Etymology. The epithet is derived from Latin "amplus" (large) and "sepalum" (sepal), referring to the very broad fringed sepals. It is to be noted that "*cristata*" is not available as a specific epithet in *Corydalis*, due to the presence of *C. cristata* Maximowicz.

Relationships. *Corydalis amplisepala* is here assigned to section *Linstowianae*, on account of being a tap-rooted biennial (or possibly annual) with erectopatent pedicels with pendent explosive fruits, and a stigma similar to that of other species in that section (e.g., *C. hemsleyana* Franchet & Prain, *C. linstowiana* Fedde). Our new species is easily distinguished from other species of section *Linstowianae* by the very large fringed sepals, the broadly winged and broadly crested corolla with upwardly curved spur, and the short broad fruits.

Corydalis pseudomucronata C. Y. Wu, Z. Y. Su & Lidén, on the other hand, belongs in section *Elatae* ser. *Mucronatae* C. Y. Wu & Z. Y. Su, which includes elegant perennials with horizontal rhizomes clothed with fleshy scales, long and lax racemes of thin-spurred flowers, and a peculiar stigma with numerous marginal papillae.

IUCN Red List category. *Corydalis amplisepala* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Series *Feddeanae* C. Y. Wu & H. Chuang

Species 19 to 24 all belong in series *Feddeanae* s.l. (including series *Trachycarpae* (Fedde) C. Y. Wu & H. Chuang), characterized by the rather deeply seated thin rhizome with fasciculate storage roots and bulblike buds; stems and petioles of radical leaves tapering to a thin underground base; leaf veins few, parallel, often raised below; corolla yellow, more rarely purple, never sky blue, often with distinct veins; fruiting pedicels sharply recurved; and capsules explosively dehiscent.

19. Corydalis dolichocentra Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan: Xiangcheng Xian, near Reda, Rizhaoshenshan [29°6′N, 99°41′32″E], alpine meadows, *Rhododendron* scrub & open scree slopes near summit, under *Quercus*, 3900–4700 m, 15 July 2004, *D. E. Boufford, J. H. Chen, S. L. Kelley, J. Li, R. H. Ree, H. Sun, J. P. Yue & Y. H. Zhang 30711* (holotype, KUN; isotype, A).

Rhizoma parvum radicibus fasciculatis anguste oblongo-elongatis indistincte stipitatis; caulis 18 cm longus, superne bi-foliatus. Folia radicalia longe petiolata, lamina triangulari bipinnata, foliolis subpinnato-lobatis lobis ovatis acutis vel obtusis; folia caulina radicalibus similia, breviter petiolata. Inflorescentia 10-flora; bracteae anguste lanceolatae vel oblanceolatae 10–16 mm longae integrae, interdum infimae parum dentatae; pedicelli 7–8 mm longi, verisimiliter in statu fructifero elongati et valde recurvati. Sepala ignota (minutissima?); petalum superum cristatum pallide azureo-purpureum apice atropurpureum, calcari longissimo apice attenuato eleganter recurvato; ovarium haud papillosum.

A *Corydale calcicola* W. W. Smith bracteis integris anguste lanceolatis ovario non papilloso plane differt.

Rhizome very short with fasciculate, very long, distally somewhat thickened storage roots; stems 18 cm including thin tapering base, naked below, with 2 leaves. Radical leaves with petiole 10–15 cm, including a thin tapering pale underground part; lamina dark green adaxially, slightly paler abaxially, triangular in outline, to 7 × 8 cm, bipinnate, with pinnulae ± deeply divided into ovate, acute to obtuse lobes; cauline leaves like radical, but smaller. Raceme (young) rather dense, probably elongating, ca. 10-flowered; bracts lanceolate to oblanceolate, 10–16 mm, entire or lowermost with a couple of teeth; pedicels 7–8 mm, probably elongating and strongly recurved in fruit. Sepals minute; corolla pale bluish purple with dark reddish purple keels and dark tips to inner petals; outer petals crested, acute; spur of upper petal long and slender, tapering toward apex, 18 mm with nectary 1/3 as long; inner petals 9 mm; stigma like in related species (*Corydalis calcicola*, *C. lhorongensis*); ovary without rows of small papillose hairs.

Etymology. The epithet is based on Greek "dolichos" (long) and "kentron" (spur), referring to the long, narrow, curved spur of this species.

Relationships. *Corydalis dolichocentra* is similar to *C. calcicola* W. W. Smith and *C. lhorongensis* C. Y. Wu & H. Chuang, but differs from both in long narrow entire bracts and nonpapillose fruits. The locality description is extremely broad, but judging from plant morphology it can be assumed that *C. dolichocentra* was collected in alpine screes, presumably in the higher altitudinal ranges.

IUCN Red List category. *Corydalis dolichocentra* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

20. Corydalis jiulongensis Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan: Jiulong, Wuxiuhai, "in piceetis likiangenses," 3830 m, 6 Aug. 1979, *Hu Y.-N. 20545* (holotype, CDBI; isotype, CDBI).

Rhizoma parvum radicibus crassis oblongis valde long-estipitatis; caules debiles, superne 2- ad 4-foliati, saepe ramosi; folia radicalia longissime petiolata, lamina triternata vel sub-bi-ternata vel subbipinnata, foliolis profunde partitis, lobis lanceolatis subtus venis prominentibus; folia caulina radicalibus similia breviter petiolata. Inflorescentia elongata 9- ad 25-flora; bracteae anguste lanceolatae integrae vel parum divisae. Sepala minutissima; corolla flava cristata acuta; petalum superum 15–17 mm longum calcari 10–12 mm longo leviter ascendenti incluso. Capsula 1- ad 4-sperma.

Rhizome small with oblong fleshy simple or rarely branched storage roots set on very long (7–15 cm) thin stalks (only stalks remaining on *Hu Y.-N. 20545*, CDBI). Stem very slender, 40–65 cm, with 2 to 4 leaves in upper half, simple or branched. Radical leaves very long stalked (to 30 cm); lamina to 8 × 10 cm, 2–3(–4) × ternate with narrowly obovate to narrowly lanceolate ultimate leaflets, green adaxially, glaucous abaxially with papillose-scabrid veins; cauline leaves like radical, but shortly stalked or sessile, decreasing in size upward, bipinnate, with entire to once divided leaflets; terminal pinna similar to lateral. Racemes 9- to 25-flowered, elongate; bracts narrowly lanceolate, tapering toward the often dark-tipped apex, entire or lower ones often deeply divided, (5–)10–15(–20) mm, with papillose-scabrid raised veins below; pedicels thin, 5–10 mm in anthesis, elongating to 10–15 mm and strongly reflexed in fruit.

Sepals finely dentate, ca. 1 mm; corolla yellow, sometimes with small brownish flecks laterally; outer petals acute with crest tapering toward apex; spur of upper petal 10–12 mm with nectary up to half as long, very slightly tapering, almost straight; inner petals 7 mm; lower petal rhombic-acute, 9 mm; stigma like other species in the series. Capsule 1- to 4-seeded, 10–13 × 2 mm, with ca. 3 mm style. Seeds smooth, slightly elliptic, ca. 2 mm, with small entire elaiosome.

Distribution and phenology. *Corydalis jiulongensis* is found in southwest Sichuan at 3500–3800 m, under deciduous shrubs and in forests in deep fertile soil, and is locally common. Flowering and fruiting in August, fruiting in September.

Etymology. The specific epithet *jiulongensis* indicates the geographic origin of the type collection.

Relationships. *Corydalis jiulongensis*, although clearly belonging in the series *Feddeanae* on account of its short rhizome with fasciculate storage roots, leaflets with parallel raised veins below, strongly recurved fruiting pedicels, explosive capsules, and stigma shape, is not similar to any other species. It deviates from other species in the series in the extremely long-stalked storage roots, the large triangular much-divided leaves, and in growing in shady places below trees and shrubs, whereas all other species in the group (except *C. mediterranea* Z. Y. Shu & Lidén and the blue-flowered *C. nemoralis* C. Y. Wu & H. Chuang) are alpine. Young plants that have not yet reached flowering size have shorter (2–5 cm) stalks to the storage roots.

IUCN Red List category. *Corydalis jiulongensis* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). The species was encountered as common during the Lidén and Yu 2006 expedition in two randomly picked locations, and so may be assumed to be locally common.

Paratypes. CHINA. **Sichuan:** Jiulong, S Jigongshan, 3800 m, 7 Aug. 2006, *Lidén & Yu S.-X. 65* (KUN, PE, UPS); Yanbian Xian, Zemulong Xiang, Zhongcao Cun, Gaoqiao She, Bailingshan, 13 Sep. 2002, *Gao X.-F., Peng Y.-L. & Sun G. 3455* (CDBI).

21. Corydalis mediterranea Z. Y. Su & Lidén, sp. nov. TYPE: China. Yunnan: Luquan xian, Wumeng shan, Daheiqing, "in mixed forest of *Abies* & *Rhododendron*, with many growing on these trees or shrubs," 3850 m, 3 July 1990, *Lü Z.-W. & Fang R.-Z. 139* (holotype, KUN).

Rhizoma parvum radicibus crassis fasciculatis oblongo-fusiformibus non distincte stipitatis; caules debiles, superne bifoliati. Folia caulina subsessilia, in foliola anguste lanceolata acuta divisa. Racemi 6- ad 8-flori; bracteae anguste lanceolatae, integrae vel parce divisae; pedicellis 6–10 mm longis. Sepala minuta; corolla flava; petala exteriora subacuta ecristata, carinis et nervis fuscioribus praedita; petalum superum 12–13 mm longum, calcari 5–6 mm longo attenuato apice parum incurvato incluso.

Glabrous herb; storage roots fasciculate, oblong, not distinctly stipitate; stems slender, to 18 cm, with 2 leaves in upper 1/3 of stem. Radical leaves unknown; leaves subsessile, deeply divided into narrowly lanceolate-acute lobes. Racemes 6- to 8-flowered, dense; bracts narrowly lanceolate, entire, or lowermost deeply cut into few acute lobes or sharp teeth; pedicels 6–10 mm. Sepals minute, dentate; corolla yellow with darker veins and keels; outer petals subacute, not or only very slightly crested; spur of upper petal 5–6 mm, with thin nectary reaching about halfway; lower petal 7 mm; inner petals 6–7 mm; ovary with 9 ovules; style ca. 2.5 mm; stigma like that of other species in the series.

Etymology. The epithet, which means "of the middle land," is based on the Latin "medius" (middle) and "terra" (land), directly translated from Chinese "Zhong-guo."

IUCN Red List category. *Corydalis mediterranea* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001). This species, known only from a single specimen, was searched for unsuccessfully in the type locality in 2004 by M. Lidén.

22. Corydalis nubicola Z. Y. Su & Lidén, sp. nov. TYPE: China. Xizang: Zogang Xian, Dongda-La, border of Markham and Zogang Xian on hwy. 318 [29°42′39″N, 98°E], scree slopes, 5100–5300 m, 25 July 2004, *D. E. Boufford, J. H. Chen, S. L. Kelley, J. Li, R. H. Ree, H. Sun, J. P. Yue & Y. H. Zhang 31129* (holotype, KUN; isotype, A).

Rhizoma parvum radicibus fasciculatis crassis oblongis (25–30 × 2–3 mm) non stipitatis; caules 11–13 cm longi superne bi-foliati. Folia radicalia longe petiolata, lamina parva ca. 30 × 25 mm triangulari bipinnata, foliolis subpinnato-lobatis, lobis late ovatis imbricatis; folia caulina radicalibus similia breviter petiolata. Inflorescentia densissima 19- ad 25-flora; bracteae obtriangulares basi cuneatae profunde 3- ad 5-fidae, lobis incisis. Sepala parva dentata; corolla purpurea apice atropurpurea; petalum superum breviter et late cristatum, calcari brevi recurvato obtuso non attenuato; ovarium haud papillosum.

A *Corydale calcicola* W. W. Smith et *C. trachycarpa* Maximowicz calcari brevi oblongo ovario non papilloso foliis multo minoribus differt.

Rhizome short with fasciculate oblong storage roots 25–30 × 2–3 mm; stems 11–13 cm, including

tapering mostly subterranean part below leaves; 2 leaves high up on stem, but as most of the stem is underground, leaves will be close to the ground; radical leaves with petiole 6–8 cm, mainly thin tapering pale underground part; lamina triangular-ovate, ca. 30 × 25 mm, bipinnate, with pinnulae deeply cut into broadly obovate overlapping lobes; cauline leaves like radical, but smaller. Raceme very densely 19- to 25-flowered; bracts flabellate, deeply divided into 3 to 5 segments that are again cut into oblong lobes, ca. 10 mm, or upper bracts smaller and less divided; pedicels 7–10 mm, soon slightly patent-arcuate, probably strongly recurved in fruit. Sepals ca. 1 × 2 mm, dentate; corolla bluish purple with dark reddish purple keels and dark tips to inner petals; outer petals broadly crested; spur of upper petal curved downward, not or very slightly tapering toward obtuse apex, 9–10 mm, with nectary almost half as long; inner petals 10–11 mm; stigma like in related species (e.g., *Corydalis calcicola*); ovary without rows of small papillose hairs.

Distribution and phenology. *Corydalis nubicola* grows in east Xizang in rough alpine screes at 4300–5300 m. Flowering in July.

Etymology. The specific epithet is based on Latin "nubes" (cloud) and the suffix "-cola" (dweller), referring to the high altitude of the type locality.

Relationships. *Corydalis nubicola* is closely related to *C. trachycarpa* and *C. calcicola*, but is easily distinguished by the short obtuse nontapering spur, glabrous fruits, and the much smaller, very distinctive leaves. With its dense broad racemes shortly above the scree surface, this must be a spectacular species in its native haunts. The description above refers to the type specimen. *Yang J. S. 90-203* (see below) deviates in smaller and apparently paler flowers (spur ca. 8 mm, inner petals ca. 8 mm) with longer nectary (ca. 5 mm), but has very similar leaves. It has a more deeply seated rhizome, so the thin stem and leaf bases are of course much longer.

IUCN Red List category. *Corydalis nubicola* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Paratype. CHINA. **Xizang:** Qamdo, Zhuogela shan, stony slope, 4300 m, 1990, *Yang J.-S. 90-203* (PE).

23. Corydalis sophronitis Z. Y. Su & Lidén, sp. nov. TYPE: China. Sichuan: Shi-Qu, Ma-ya Gong-she, Re-bai-gou, 4000 m, 7 July 1979, *Coll. Ganze pref. 0211* (holotype, SCMI).

Rhizoma breve; radicibus crassis fasciculatis anguste oblongis non vel indistincte stipitatis; caules debiles 2- ad 4-foliati. Folium radicale longe petiolatum, lamina ternata, foliolis profunde tripartitis, lobis lineari-lanceolatis ca. 20 × 2 mm; folia caulina radicalibus similia breviter petiolata. Inflorescentia multiflora elongata; bracteae integrae anguste lanceolatae substipitatae, pedicellos aequantes; pedicelli fructiferi valde reflexi. Sepala parva dentata; corolla pallide flava; petala exteriora late et breviter cristata; petalum superum 12 mm longum, calcari brevi 5–6 mm vix attenuato apice recurvato.

Glabrous herb; storage roots narrowly oblong, tapering below and above to indistinct stalk; stem 18–70 cm, ± branched. Radical leaf (only one seen) rather large; petiole 8 cm; lamina triangular in outline, ca. 5 × 5 cm, ternate with leaflets deeply tripartite into linear lobes; cauline leaves 2 to 4, shortly stalked, pinnate with (1 to)2 to 3 pair of leaflets, often lowermost leaflets divided; ultimate lobes or leaflets narrowly lanceolate, to 65 × 7 mm in shade-grown luxuriant specimens but usually smaller, with 3 rather prominent veins. Racemes 10- to 29-flowered, dense at first, soon elongating to 10–15 cm in fruiting stage; bracts entire or rarely lowermost with a tooth or lobe, narrowly lanceolate, usually with short stalk, 5–13 mm, equaling pedicels that are strongly recurved in fruit. Flowers pale yellow; sepals rounded, dentate, ca. 1 × 1.5 mm; outer petals shortly and broadly crested; spur of upper petal short, 5–6 mm, recurved, hardly tapering toward obtuse apex, with nectary ca. half as long; inner petals ca. 7 mm with claw slightly shorter than limb; lower petal 7(–8) mm, with indistinct claw, subelliptic in outline, apically with short high entire to finely undulate-dentate crest; stigma rather like other species in this series, but more delicate with less-pronounced apical papillae. Capsule 2- to 5-seeded, smooth or finely papillose along veins, oblong, ca. 9 × 2 mm, with style ca. 2.5 mm. Seed smooth, rounded, almost 2 mm.

Distribution and phenology. *Corydalis sophronitis* is known only from northwest Sichuan close to the town Serxu, at 3500–4000 m. Flowering and fruiting in July.

Etymology. The epithet is based on Greek "sophron" (shy, modest), referring to the small pale flowers and thin stems.

Relationships. *Corydalis sophronitis* is similar to *C. linearis* C. Y. Wu in its small flowers and entire, shortly stalked bracts, but differs in its narrow tapering curved spur.

IUCN Red List category. *Corydalis sophronitis* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Paratype. CHINA. **Sichuan:** Serxu Xian N of Luoxu on rd. to Shiqu (Serxu), S of Shengbuka pass, among shrubs in remnant *Picea* forest, 3550 m, 30 July 2005, *D. E. Boufford, J. H. Chen, K. Fujikawa, S. L. Kelley, R. H. Ree, H. Sun, J. P. Yue, D. C. Zhang & Y. H. Zhang 33880* (A, KUN, UPS).

24. Corydalis tenuipes Lidén & Z. Y. Su, sp. nov. TYPE: China. Xizang: Shiuden Gompa prope Ata kang La [29°25′N; 96°50′E], in praeruptis et clivis, 5000–5300 m, 3 Sep. 1933, *F. Kingdon-Ward 10812* (holotype, BM).

Rhizoma parvum radicibus crassis fasciculatis anguste fusiformibus indistincte stipitatis; caules plures debiles, superne bi vel tri-foliati, saepe ramosi. Folia radicalia longe petiolata, lamina ternata usque sub-bi-ternata vel subbipinnata, foliolis profunde tripartitis, lobis lanceolatis subtus crassimarginatis venis prominentibus; folia caulina radicalibus similia breviter petiolata. Inflorescentia 7- ad 15-flora corymbosa; bracteae inferiores divisae, superiores integrae, pedicellis longissimis 15–30 mm longis breviores. Sepala parva profunde dentata; corolla flava brunneonervosa, calcari brevi vix attenuato apice haud recurvato; crista petalorum superiorum utrinque attenuata apicem calcaris vix attingens.

Corydali delavayi Franchet affinis sed inflorescentiis corymbosis pedicellis multo longioribus radicibus non distincte stipitatis facile distinguenda.

Glabrous herb; storage roots narrowly fusiform, gradually narrowed into short or long stalk; stems usually several, weak, 8–18 cm, simple or often branched with 2 or 3 leaves in upper half; radical leaves with petiole 4–11 cm; lamina once to twice subternately or pinnately divided; leaflets glaucous, especially abaxially, ± deeply divided into lanceolate acute lobes, often tipped with small black mucro; cauline leaves like radical, or once to twice subpinnately divided, shortly stalked. Racemes terminal and often axillary from uppermost leaf, corymbose, later elongating, 7- to 15-flowered; lower bracts divided, upper bracts entire, shorter than the slender, 15–25 (–30) mm pedicels that become arcuate-recurved in fruit. Flowers fragrant, yellow, veins and keels of outer petals dark purplish brown; sepals whitish, up to 1 mm, deeply dentate; outer petals acute, broadly crested, crest not quite reaching apex and gradually attenuate toward tip of 7–8 mm straight slightly tapering spur with thin nectary 1/3 to 2/3 as long; inner petals 6–7 mm, pale at apex; ovary broadly ellipsoid with ca. 3 mm style.

Distribution and phenology. *Corydalis tenuipes* is known from two localities in east Xizang and southwest Sichuan at 4100–5300 m, growing in wet alpine screes and disturbed sites. Flowering July and August.

Etymology. The epithet is based on Latin "tenuis" (thin, weak) and "pes" (foot), referring to the thin tapering stem base.

Relationships. *Corydalis tenuipes* is similar to *C. delavayi* in that the leaflets are not so discretely set off as in related species (i.e., the leaves are subpinnatifid rather than completely pinnate), but it is distinguished by the corymbose racemes of long-stalked flowers and the different roots. In *C. delavayi* the storage roots are cylindrical, terminating long thin stalks. The localities of *C. tenuipes* are remarkably disjunct. In the Sichuan locality, the new species occurs together with *C. delavayi*, but the two species are morphologically and ecologically distinct with no intermediates.

IUCN Red List category. *Corydalis tenuipes* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Paratypes. CHINA. **Xizang:** Basu, Ranwu District, Quchi to Gula, 4100 m, 14 Aug. 1973, *Qing-zang Exp. 73-1145a.* (PE p.p). **Sichuan:** Jiulong xian, Tanggu Cun, 4250–4600 m, 18 June 2005, *D. E. Boufford, J. H. Chen, K. Fujikawa, S. L. Kelley, R. H. Ree, H. Sun, J. P. Yue, D. C. Zhang & Y. H. Zhang 33215* (A, KUN, UPS).

Series *Appendiculatae* C. Y. Wu & H. Chuang

Species 25 and 26 belong in series *Appendiculatae*, characterized by rather deeply seated thin rhizome with fasciculate storage roots and bulblike buds; thin unbranched stems; stems and petioles of radical leaves tapering to a thin underground base; leaves not with raised parallel veins below; corolla sky blue, rarely pink to purple; fruiting pedicels sharply recurved; and capsules explosively dehiscent.

25. Corydalis ischnosiphon Lidén & Z. Y. Su, sp. nov. TYPE: China. Yunnan: Zhongdian, midway from Nixiyaola to Secong, in alpine meadow and edge of bush wood, 3300 m, 7 July 1988, *Fang Z.-D. 0882* (holotype, KUN).

Rhizoma parvum radicibus fasciculatis crassis fusiformibus non distincte stipitatis; caulis 30–35 cm longus, superne bi-foliatus. Folia radicalia ternata vel sub-quinata, lobis obovatis grosse dentatis; folia caulina sessilia profunde 5- ad 7-inaequi-partita, lobis lineari-lanceolatis acutis. Inflorescentia laxa, 8- ad 13-flora; bracteae lineari-lanceolatae. Sepala minutissima; corolla azurea; petalum superum haud cristatum calcari longo gracili vix recurvato.

Fasciculate storage roots fusiform, ca. 20–25 mm, without distinct stalks; stem single (?), erect, slender, unbranched, 30–35 cm, naked below, with 2 leaves in upper half. Radical leaves with petiole 4–6 cm; lamina green adaxially, glaucous abaxially, 25–30 × 30–40 mm, ternately divided into subsessile leaflets; lateral leaflets often again deeply bifid; lobes obovate, 15–25 × 5–10 mm, coarsely toothed; cauline leaves sessile, deeply digitately cut into 5 to 7 narrowly lanceolate acute lobes, entire or with 1 or 2 long acute lateral teeth. Racemes long and lax, ca. 10 cm, 8- to 13-flowered; bracts linear-lanceolate, 10–15 mm, entire or lowest bracts with 1 or 2 long narrow basal lateral teeth or lobes; pedicels 7–16 mm, reflexed in fruit. Flowers blue; sepals minute; outer petals without crest, subacute, spur long and narrow, slightly curved, not or very slightly tapering toward

apex, ca. 11 mm, with nectary at least half as long; inner petals 7–8 mm; ovary fusiform with style ca. 3 mm; number of ovules not noted; stigma similar to that of other species in the series.

Etymology. The epithet is based on Greek "ischno-" (thin) and "siphon" (tube), referring to the long thin spur.

Relationships. *Corydalis ischnosiphon* is similar to *C. pseudobalfouriana* Lidén & Z. Y. Su in the cauline leaf shape, long racemes, narrow bracts, and recurved fruiting pedicels, and indeed was initially determined as this species, which however differs considerably in roots with distinct thin stalks, radical leaves with small rounded entire leaflets, short pedicels to 5 mm long, cristate corolla, and shorter spur to 6 mm long.

IUCN Red List category. *Corydalis ischnosiphon* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

26. Corydalis heterothylax C. Y. Wu ex Z. Y. Su & Lidén, sp. nov. TYPE: China. Yunnan: Hong shan N Zhongdian [28°07.633′N, 99°54.017′E], alpine slope, moist grass turf, 4300 m, 15 Aug. 2004, *M. Lidén 2004: 2* (holotype, KUN; isotypes, MO, UPS).

Rhizoma parvum radicibus fasciculatis crassis fusiformibus indistincte stipitatis; caulis 7–20(–35) cm longus superne bi-foliatus. Folia radicalia parva ternata, foliolis brevistipitatis profunde divisis, lobis obovatis acutis; folia caulina subsessilia profunde bi-tri-ternato-partita, lobis linearo-lanceolatis acutis. Inflorescentia 3- ad 10-flora; bracteae lanceolatae integrae vel bractea ima interdum trilobata. Sepala minutissima; corolla azurea; petalum superum late cristatum calcari oblongo vix recurvato; petalum inferum basi conspicue marsupiatum. Capsula ignota.

Fasciculae storage roots 5–15 mm, fusiform; stems 7–20(–35) cm, ± erect, unbranched, with 2 leaves in upper part. Radical leaves with petiole 2–7 cm, lamina green adaxially, glaucous abaxially, rounded-triangular in outline, 10–15 × 15 mm, ternately divided; leaflets shortly stalked, once to twice ± deeply divided into broadly obovate to lanceolate acute lobes; cauline leaves subsessile, 10–25 mm, twice to thrice deeply cut into linear-lanceolate acute lobes. Racemes 3- to 10-flowered, slightly elongating in fruit; bracts lanceolate, 4–12 mm, entire or lowermost one occasionally with a couple of narrow lateral lobes; pedicels 5–14 mm (upper ones shortest), recurved in fruit. Sepals very small; corolla sky blue with violet markings toward apices of petals (excluding crests); dorsal wings of inner petals white (as in many other blue-flowered species of *Corydalis*); outer petals broadly crested; spur rather short and broad, almost straight, not tapering toward obtuse very slightly recurved apex, 7–10 mm, with nectary 1/2 to 2/3 as long; inner petals 7–9 mm, with dorsal crests slightly overtopping apex; lower petal dilated into broad rounded limb; claw with conspicuous pouch at the base, like a diminutive spur; ovary with 7 to 10 ovules and ca. 2.5 mm style, stigma like that of *C. appendiculata*. Mature capsule not seen; very immature capsule narrowly fusiform.

Distribution and phenology. *Corydalis heterothylax* grows in northern Yunnan and southwest Sichuan at 3600–4800 m, in the grass of alpine meadows or possibly in dry screes at the highest elevations. Flowering in July and August.

Etymology. The epithet is based on Greek "heteros" (different) and "thylax" (bag or pouch), referring to the conspicuous pouch of the lower petal. Although much smaller than the spur of the upper petal, it is still prominent enough to be noticed as a poorly balanced counterpart.

Relationships. *Corydalis heterothylax* is related to *C. appendiculata* Handel-Mazzetti, from which it is easily distinguished by the robust habit, broader and much more broadly crested outer petals, larger nectaries, a lower petal with much more pronounced gibbosity, and by the smaller radical leaves. *Corydalis heterothylax* was provisionally noted by Prof. Wu Cheng-Yih (as *C. hsiangchangensis* in PE and KUN), but was never formally described. After seeing both species alive in the Hong shan area in northern Yunnan in 2004 and noting their very different growth habits and habitats (*C. heterothylax*: alpine grass turf; *C. appendiculata*: cliffs, screes, and disturbed patches in grassland from 3000–3900 m), we have no hesitation in recognizing two species. Also, no intermediate specimens are known. The related *C. yargongensis* C. Y. Wu has very broad emarginate outer petals and narrow (if any) crests to the outer petals, and lacks the pouch on the lower petal.

IUCN Red List category. *Corydalis heterothylax* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). The species is rather common in the type locality, and is known from several collections over a rather wide area.

Paratypes. CHINA. **Sichuan:** Daochen/Xiangcheng, Yiqu, Chaoyanggou, Huashan, 4800 m, 17 Aug. 1973, *Daocheng Exp. 3163* (CDBI); Kangding, Xingdu qiao (bridge), 3600 m, 19 July 1963, *Kuang K.-C. & Wang W.-T. 730* (PE); s. loc., *s. coll. 662* (PE); Xiangcheng, Xian Haizi Lake, on rd. betw. Sandui & Litang, 4350 m, 12 July 1998, *D. E. Boufford, B. Bartholomew, C. Y. Chen, M. J. Donoghue, R. H. Ree, H. Sun & S. K. Wu 28605* (A, KUN).

Series *Curviflorae* C. Y. Wu & H. Chuang

27. Corydalis nematopoda Lidén & Z. Y. Su, sp. nov. TYPE: China. Qinghai: Valley S of Baima along Makehe river [32°50′02″N; 100°50′02″E], steep hillsides with scrub cover, 3360 m, 8 July 2000, *C. D. Brickell, H. Jans, J. Mitchell, H. S. Maxwell, S. Pettit, Ho T.-N., Liu S.-W., Liu X.-F. & Chen S.-L. SQAE (Sino-British Qinghai Alpine Garden Society Expedition) 782* (holotype, E).

Rhizoma parvum radicibus fasciculatis numerosis tenuibus; caules eramosi tenues, basin nudi valde attenuati, superne bi-tri-foliati. Folia radicalia longe petiolata, lamina rotundata ternata usque quinata, foliolis bi-tri-lobatis lobis linearo-oblongis; folia caulina radicalibus similia, profunde 3- ad 8-divisa, lobis linearibus. Racemus 5- ad 16-florus subspicatus; bracteae anguste lanceolatae subobtusae 5–10 mm longae; pedicelli breves in statu fructifero valde elongati erecto-patentes. Corolla parva cremea late cristata, calcari perparvo rotundato; cristae dorsales petalorum interiorum apices superantes. Capsula pendula obovoidea.

Rhizome small with several long thin fasciculate roots; stems unbranched, slender, 18–26 cm, leafless in lower 1/3 or 1/2, above with 2 or 3 leaves. Radical leaves long stalked (5–7 cm), not withered in early fruiting stage; lamina green adaxially, glaucous abaxially, rounded, 20–30 mm broad, deeply divided into 3 to 5 leaflets that are again cut into 2 to 3 linear-oblong lobes; cauline leaves like radical, deeply cut into 3 to 8 linear lobes. Racemes 5- to 16-flowered, subspicate; bracts narrowly lanceolate, subobtuse, 5–10 mm, or lowermost much larger and occasionally divided like uppermost leaf; pedicels short in anthesis, elongating considerably to 15–20 mm and erectopatent in fruit. Sepals minute; corolla cream with brownish yellow keels; outer petals broadly crested; upper petal with short spur ca. 4 mm; lower petal 9–10 mm; inner petals 7–8 mm; dorsal crests of inner petals overtopping apex, yellow, turning brownish after pollination; stigma like that of *Corydalis cytisiflora*, but basal corners more pronounced. Capsule broadly obovoid, pendent from suberect pedicels, ca. 7 × 3.5 mm, tipped by 2.5 mm style; seeds 2 to 5, ca. 2 × 1.5 mm with short and broad elaiosome.

Etymology. The epithet is based on Greek "nema" (thread) and "pous" (foot), referring to the thin tapering bases of stems and of petioles of radical leaves.

Relationships. *Corydalis nematopoda* is placed in the series *Curviflorae*, based on the deeply seated small rhizome with fasciculate storage roots, the slender erect unbranched stems, the digitately divided cauline leaves with narrow obtuse leaflets, the small corolla with short obtuse spur, the dorsal crests of inner petals that clearly overtop the apex, the fruiting pedicels that are erect with pendent explosively dehiscent fruits, and the peculiar stigma. It belongs in the *C. cytisiflora* complex, which is characterized by long thin storage roots, but is easily distinguished from all the other species by the short spurs (4 mm vs. 6–9 mm) and broadly obovoid (vs. linear) capsules. Furthermore, all other species in this complex except *C. cytisiflora* (Fedde) Lidén have blue flowers.

IUCN Red List category. *Corydalis nematopoda* should be classified as DD (Data Deficient) according to IUCN criteria (IUCN, 2001).

Section *Kingiae* C. Y. Wu & Z. Y. Su

Species 28 and 29 belong in the section *Kingiae* s.l., including section *Flaccidae* C. Y. Wu and section *Capnogorium* (Bernhardi) Endlicher sensu Wu et al. (1999), but excepting the type species *Corydalis nobilis* (L.) Persoon and *C. chingii* Fedde. The section is characterized by robust vertical rootstock crowned by a lax rosette of pinnately divided leaves, leafy stems, and oblong capsules that do not dehisce explosively. Details of stigma and seed are also peculiar to this section.

28. Corydalis cheilosticta Z. Y. Su & Lidén, sp. nov. TYPE: China. Qinghai: 34°33′48″N, 100°33′28″E, amongst shrubs in gully, in dry valley, 3500 m, 10 July 1997, *D. Long, C. Brickell, R. McBeath, E. Strangman, R. Steele, Lu X.-F., Deng S.-R., Zhang S.-R. SBQ (Sino-British Qinghai exp.) 459* (holotype, E).

Herba perennis radice robusta apice squamis marcescentibus; caules ramosi 4- ad 8-foliati, foliis sursum decrescentibus; folia caulina mediana et inferiora subsessilia anguste oblongo-ovata 5-jugo-pinnata, foliolis primariis (infimis ceteris minoribus) brevipetiolatis ternatis vel subpinnatis, foliolis secundariis 2- ad 5-divisis, lobis late obovatis obtusis plerumque mucronulatis. Racemi densiflori, in statu fructifero elongati; bracteae (infimae exceptae) integrae, ambitu obovato-rhombicae, basi cuneatae apice anguste acutatae, plerumque subtiliter eroso-denticulatae; bracteae infimae plerumquae divisae, superiores minores angustiores; pedicelli 6–7 mm longi, in statu fructifero arcuato-recurvati et ad 9–15 mm elongati. Sepala ovata usque lanceolata dentata; corolla anguste cristata cremea petalo infimo margine carmesino, calcari oblongo obtuso nectario duplo longiore. Capsula anguste oblonga 3- ad 6-seminata.

A *Corydale straminea* Maximowicz differt foliis caulinis foliolis basalibus stipuliformibus, petalis exterioribus distincte cristatis carmesino-marginatis.

Rootstock stout, vertical, densely clothed at apex by dead petiole bases; stems rather long and slender, 25–55(–85) cm, 1.5–5 mm thick, lower 1/3 usually leafless, 4 to 8 leaves above, most of them with axillary flowering branches but lowermost ones

usually appearing later. Cauline leaves subsessile, narrowly oblong-ovate in outline, pinnate with basal pair of pinnae smaller than second pair; usually with 5 (rarely 6) pairs of pinnae; lower and middle cauline leaves 8–17 × 3–5 cm; upper cauline leaves much smaller; leaflets shortly stalked, subpinnately or ternately divided with leaflets cut into 2 to 5 broadly obovate usually mucronate lobes; radical leaves like cauline but with long petioles 4–10 cm, lamina 6–11 × 3–5 cm. Racemes 7- to 15-flowered, dense, elongating in fruit; bracts obovate-rhombic, cuneate at base, tapering to a narrowly triangular acute apex, entire or lowermost one usually divided, often slightly erose-dentate toward apex, 3–7 mm; upper bracts narrower and shorter; pedicels 6–7 mm, elongating to 9–15 mm and arcuately recurved in fruit. Sepals ovate to lanceolate, dentate, 3–4 × 1–2 mm; corolla cream with red margins to lower lip, crested; spur of upper petal 9–12 mm, hardly tapering toward obtuse apex, straight or slightly sigmoidally curved; nectary reaching halfway through spur; lower petal with narrow straight basal third, slightly saccate at middle, and with indistinctly set off limb with sharply contrasting crimson or purplish brown margins; inner petals 9–11 mm; stigma like that of *Corydalis straminea*. Capsule narrowly oblong, 15–25 mm with 2 mm style, 3- to 6-seeded, slightly constricted between seeds, at least in the dry state.

Distribution and phenology. *Corydalis cheilosticta* grows in southeast Qinghai on moist rocky slopes at 3300–3600 m. Flowering and fruiting in July.

Etymology. The epithet is based on the Greek "cheilos" (lip) and "stictos" (spotted), referring to the red margins of the lower (and occasionally upper) petal.

Relationships. *Corydalis cheilosticta* differs from the closely related *C. straminea* in its innermost pair of leaflets of cauline leaves stipule-like, obtuse leaf lobes, lower (or both) outer petal with red margin, and outer petals distinctly crested.

IUCN Red List category. *Corydalis cheilosticta* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). It has been collected recently in a few scattered localities, and so may be assumed not to be threatened.

Paratypes. CHINA. **Qinghai:** [34°38′54″N, 100°36′32″E], mossy calcareous ledges under *Juniperus*, 3585 m, 10 July 1977, *D. Long, C. Brickell, R. McBeath, E. Strangman, R. Steele, Lu X.-F., Deng S.-R., Zhang S.-R SBQ 488* (E); [34°36′N, 100°33′E], rocky banks by stream, 3550 m, 10 July 1977, *D. Long, C. Brickell, R. McBeath, E. Strangman, R. Steele, Lu X.-F., Deng S.-R., Zhang S.-R SBQ 504* (E); [34°29′1″N, 101°8′32″E], steep rocky sides of river gorge, 3340 m, 16 July 1997, *D. Long, C. Brickell, R. McBeath, E. Strangman, R. Steele, Lu X.-F., Deng S.-R., Zhang S.-R SBQ 741* (E).

The description above pertains only to *Corydalis cheilosticta* subsp. *cheilosticta* and only those details that contrast are provided in the diagnosis of subspecies *borealis* below:

28a. Corydalis cheilosticta subsp. **borealis** Lidén & Z. Y. Su, subsp. nov. TYPE: China. Gansu: in montibus Richthofen (Nan shan), Hung-Shui-Pa-Shang-Ho, 4000 m, 20 July 1931, *Friis-Johansen 2700* (holotype, S).

Petalis exterioribus latioribus obscureo-purpureis a subsp. *cheilosticta* differt.

Distribution and phenology. *Corydalis cheilosticta* subsp. *borealis* grows in eastern Qinghai and neighboring Gansu at 3500–4000 m on rocky hillsides. Flowering in July.

Relationships. The new subspecies differs from *Corydalis cheilosticta* subsp. *cheilosticta* in its broader outer petals that are "muddy pink-purple" (in sched., *SBQ 291*, E). Because there are other species in the genus in which flower color is variable, there are no vegetative differences, and the two types are geographically vicariant, we find subspecific level appropriate.

IUCN Red List category. *Corydalis cheilosticta* subsp. *borealis* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). It has been collected recently in a few scattered localities, and so may be assumed not to be threatened.

Paratypes. CHINA. **Gansu:** in montibus Richthofen (Nan shan), Hung-Shui-Pa-Shang-Ho, 4000 m, 20 July 1931, *Friis-Johansen 2633* (S). **Qinghai:** Maqen, N Dawu (Maqen), near powerstation, Jiang ran valley, 3500 m, 7 July 1997, *D. Long, C. Brickell, R. McBeath, E. Strangman, R. Steele, Lu X.-F., Deng S.-R., Zhang S.-R. SBQ (Sino-British Qinghai exp.) 291* (E).

29. Corydalis lophophora Lidén & Z. Y. Su, sp. nov. TYPE: China. Qinghai: Maqen xian, Xueshan, along Qiemuque He, [34°43′0″N, 99°41′13″E], rocky cliff, 3800 m, 27 July 1993, *Ho T.-N., B. Bartholomew & M. Gilbert 376* (holotype, PE; isotype, E).

Herba perennis radice robusta apice squamis marcescentibus; caules plures 4- ad 5-foliosi, foliis sursum decrescentibus; folia radicalia longepetiolata, ambitu triangularia sub-bipinnata, foliolis primariis petiolatis, secundariis subbiternato-lobatis vel ternatolobatis lobis obovatis; folia caulina subsessilia oblongo-ovata 2–3(–4)-jugo-pinnata, foliolis (pari infimo minore distanti stipulas mentienti) subpinnatifidis, lobis late obovatis obtusis. Racemi 9- ad 15-flori subsecundi densiusculi, in statu fructifero elongati; bracteae integrae ambitu obovato-rhombicae, basi cuneate

vel brevissime petiolatae apice acuminatae; bractea infima plerumque divisa, superiores minores angustiores; pedicelli 7–8 mm longi, in statu fructifero arcuato-recurvati usque ad 12 mm elongati. Sepala magna ovata lacerato-dentata, nervo medio prolongato; corolla purpurea vel purpurascens late et breviter cristata, calcari oblongo obtuso nectario duplo longiore. Capsula ignota.

Corydali cheilostictae Z. Y. Su & Lidén similis, sed caulibus brevioribus foliis caulinis pari foliolorum basali ex ceteris manifeste distanti, sepalis majoribus petalis exterioribus late cristatis non carmesino-marginatis distat. A *C. praecipitorum* C. Y. Wu, Z. Y. Su & Lidén et *C. crista-gallii* Maximowicz differt caulibus plurifoliatis foliis radicalibus magis divisa sepalis majoribus magis divisis et praetera a priore calcari longiore crista latiore.

Rootstock stout, crowned by remnants of petioles; stems several, 20–30 cm, with 4 or 5 leaves, with axillary racemes from uppermost leaves. Radical leaves 14–25 cm, including petiole 7–8 cm, triangular in outline, sub-bipinnate; basal primary leaflets rather long stalked, upper ones short stalked; leaflets ternately cut to ca. 2/3 into obovate lobes that are often again shallowly 2- to 3-fid; cauline leaves simply pinnate, subsessile, usually with lowermost pair of pinnae small, distant from the other and stipular in appearance; leaflets ovate in outline, shallowly subpinnatifid into broad obtuse lobes. Racemes subsecund, 9- to 15-flowered, rather dense, elongating in fruit; often axillary (leafless) racemes are produced from uppermost leaves; bracts obovate-rhombic, entire, cuneate at base or with rather distinct stalk, acuminate at apex, ca. 5–7 mm, or upper ones smaller and narrower; lowermost bract occasionally larger and slightly divided; pedicels 7–8 mm, elongating to 12 mm and arcuate-recurved in fruit. Sepals large, 5–8 × 3–4 mm, lacerate-dentate, often with midvein prolonged into a little tail; corolla "pink and white" (in sched., *Ho et al. 593*, PE) "purple to lilac, tube and margins of lower lip darker" (in sched., *SBQ 371*, PE), "dull pink with white lower lip" (in sched., *Ho et al. 376*, PE); outer petals with high and short crests; spur 10–13 mm, not tapering toward the obtuse slightly downcurved apex; nectary about half as long as spur; lower petal broadly saccate (except for the very base), broadly subacute; inner petals 10–12 mm, darker at apex.

Distribution and phenology. *Corydalis lophophora* grows in Qinghai on rocky cliffs at 2600–3800 m. Flowering in June and July.

Etymology. The epithet is based on Greek "lopho" (crest) and "-phorum" (carrier), referring to the prominent crests of the outer petals.

Relationships. *Corydalis lophophora* differs from *C. cheilosticta* by its shorter stems without axillary leafy branches, comparatively larger radical leaves that are triangular in outline, and quite different flowers. It further differs from *C. praecipitorum* by its more leafy stems, broader and more divided radical leaves, and flowers with considerably larger and more divided sepals, longer spur, and broader crests. *Corydalis crista-galli* is similar in the broadly crested flowers, but has very different leaves, smaller sepals, and the lower petal has a contrasting purple blotch across the crest and apex.

IUCN Red List category. *Corydalis lophophora* should be classified as LC (Least Concern) according to IUCN criteria (IUCN, 2001). It has been collected recently in a few scattered localities, and so may be assumed not to be threatened.

Paratypes. CHINA. **Qinghai:** [34°47′40″N, 99°45′1″E], 3630 m, 9 June 1997, *D. Long, C. Brickell, R. McBeath, E. Strangman, R. Steele, Lu X.-F., Deng S.-R., Zhang S.-R. SBQ (Sino-British Qinghai exp.) 371* (E); Maqen xian, Dawu Xiang, Ehema along Gequ He, river valley, 3600 m, 31 July 1993, *Ho T.-N., B. Bartholomew & M. Gilbert 593* (PE); Maqen, 2600–2700 m, 12 June 1981, *Huang R.-F. CG81-0028* (BM, HNWP).

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Tres Nuevas Especies en el Género *Bulbostylis* (Cyperaceae) de Sudamérica

M. Gabriela López

Instituto de Botánica del Nordeste, Facultad de Ciencias Agrarias UNNE-CONICET, C.C. 209, 3400 Corrientes, Argentina. mglopez@agr.unne.edu.ar

Resumen. Se describen e ilustran tres nuevas especies de *Bulbostylis* Kunth (Cyperaceae) de Sudamérica: *B. aspera* M. G. López del noreste de Argentina y centro del Paraguay oriental, esta especie fue confundida con *B. hirtella* (Schrader ex Schultes) Nees ex Urban; *B. guaglianoneae* M. G. López de Misiones, Argentina, es afín a *B. sphaerocephala* (Boeckeler) Lindman; y *B. subtilis* M. G. López del noreste de Argentina, centro-oeste de Bolivia, sudeste de Brasil y Paraguay oriental, que se asemeja a *B. loefgrenii* (Boeckeler) Prata & M. G. López.

Abstract. Three new species of *Bulbostylis* Kunth (Cyperaceae) from South America are described and illustrated: *B. aspera* M. G. López of Argentina and the center of eastern Paraguay, which was previously confused with *B. hirtella* (Schrader ex Schultes) Nees ex Urban; *B. guaglianoneae* M. G. López of Misiones, Argentina, which is related to *B. sphaerocephala* (Boeckeler) Lindman; and *B. subtilis* M. G. López of northeastern Argentina, center-west Bolivia, southeastern Brazil, and eastern Paraguay, which resembles *B. loefgrenii* (Boeckeler) Prata & M. G. López.

Key words: *Bulbostylis*, Cyperaceae, South America.

Bulbostylis Kunth nom. cons. (Cyperaceae) comprende ca. 150 especies de plantas anuales o perennes, de tallos escaposos, inflorescencia en antelodio, capitada o uniespiculada; espiguillas densamente espiraladas, flores bisexuales desprovistas de cerdas, estigmas 3(2), base del estilo persistente sobre el aquenio (estilopodio), algunas veces caduco. Aquenio redondeado a trígono, rara vez dorsiventralmente lenticular. Es de distribución Pantropical, con centros de variación de especies en África y Sudamérica.

Durante la revisión de *Bulbostylis* para Sudamérica, al analizar gran cantidad de ejemplares, se observó que los patrones epidérmicos de la superficie del aquenio son diferentes y consistentes para cada taxón. Tomando como base este carácter, se encontraron tres nuevas especies, *B. aspera* M. G. López y *B. subtilis* M. G. López con inflorescencias en antelodio, y *B. guaglianoneae* M. G. López con inflorescencia capitada.

Material y Métodos

Para la preparación de este trabajo se estudiaron ejemplares de los herbarios BAB, CTES, G, MO, PY, SI, y se realizaron observaciones de plantas vivas en el campo.

Se extrajeron frutos de ejemplares de herbario, se montaron en una platina de cobre y se metalizaron con oro paladio. Para su observación se utilizó microscopio electrónico de barrido (SEM), JOEL 5800 LV de la Universidad Nacional del Nordeste–Secretaría General de Ciencia y Técnica (UNNE-SECyT). La observación de los frutos se realizó a 15 kV y se tomaron fotografías digitales.

Resultados y Discución

1. Bulbostylis aspera M. G. López, sp. nov. TIPO: Argentina. Corrientes: dep. Concepción, 11 km NW de Santa Rosa, dic. 1977, *S. G. Tressens et al. 921* (holotipo, CTES; isotipo, Z no visto). Figura 1A–M.

Herba caespitosa usque 65 cm alta, laxe hispida. Folia 1.5–18 cm, lamina filiformi, vaginae ore copiose ciliato. Inflorescentia antelodium, simplex vel composita. Spicae 3–6 × 1.5–2.5 mm, 4- ad 16-floriferae; glumae ovato-naviculares, acutae. Achaenium trigonum, oblongum, 1.3 × 0.75 mm, transversim rugosum, stylopodio plano.

Hierba cespitosa, 3.5–65 cm; escapo 3–58 × 0.025–0.06 cm, trígono o subtrígono, 7 costillas en transcorte, laxamente híspido. Hojas 1.5–18 cm; lámina 1.1–17 cm, filiforme, cara adaxial levemente cóncava a plana, cara abaxial 3-nervada, híspida en bordes y nervios; vaina foliar 0.4–3 cm, membranácea, ferrugínea, bordes pajizos, lineadas longitudinalmente, híspida, ápice largamente ciliado, cilias de 1–3.75 mm. Inflorescencia, antelodio simple o compuesto, el eje principal termina en una espiguilla o en un fascículo, 1 a 4 ejes primarios, erectos o divergentes, 1 a 2 ejes secundarios, bráctea inferior del involucro de menor o mayor longitud que la

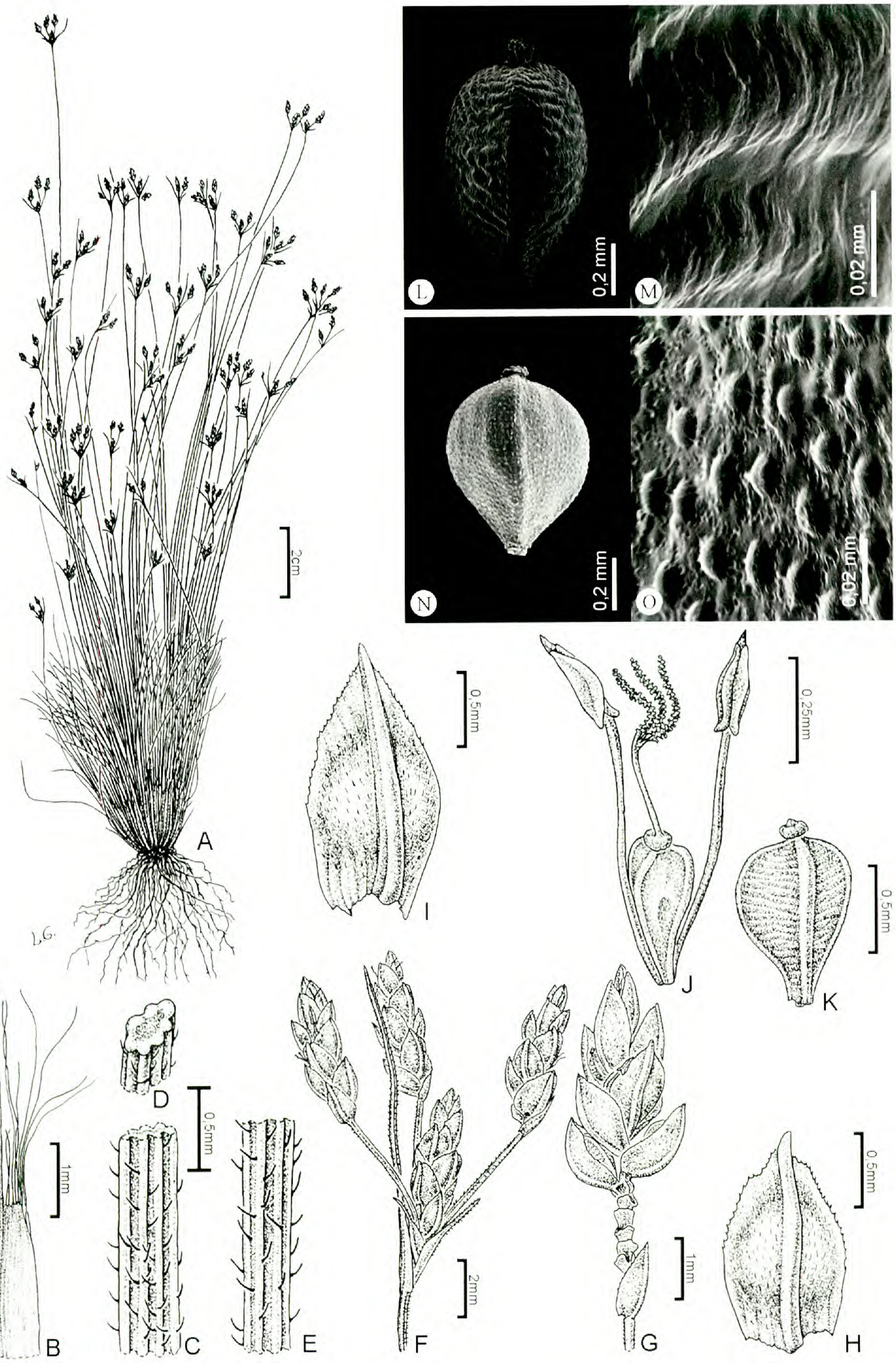

Figura 1. A–M. *Bulbostylis aspera* M. G. López. —A. Planta. —B. Vaina. —C, D. Parte del tallo. —E. Parte de la lámina foliar, cara abaxial. —F. Inflorescencia. —G. Espiguilla sin las flores inferiores. —H, I. Glumas vista dorsal. —J. Flor. —K. Fruto. L, M. Fotomicrografías de frutos. —L. Fruto entero. —M. Detalle de la superficie (del tipo *Tressens 921*, CTES). N, O. Fotomicrografías de frutos de *Bulbostylis hirtella*. —N. Fruto entero. —O. Detalle de la superficie (*Schinini et al. 28211*, CTES).

inflorescencia. Espiguillas de 3–6 × 2.5 mm, 4- a 16-floras; bráctea glumácea, con mucrón de 0.5 mm, escabroso, gluma inferior con mucrón más corto y las siguientes sin mucrón, ovado-naviculares, agudas, 1.5–2 × 1.5 mm, ferrugíneas con máculas castañas, ca. de la carena, superficie hispídula, bordes hialinos, ciliolados, carena trinervia; estilo de ca. 0.25 mm, estigma trífido; estambres 2, anteras 0.25 mm. Aquenio oblongo-trígono de ca. 1.3 × 0.75 mm, atenuado en la base formando un estípite, gris con aristas marcadas, más claras, superficie con arrugas transversales, formada por células alargadas con la pared tangencial externa convexa, paralelas al eje longitudinal del fruto; estilopodio plano.

Fenología. Florece y fructifica de agosto hasta abril.

Distribución geográfica y ecología. Bulbostylis aspera habita en el noreste de Argentina y en el centro del Paraguay oriental. Crece en suelos bajos y espartillares.

Discusión. Bulbostylis aspera posee hojas y escapos laxamente híspidos, por lo que fue confundida con *B. hirtella* (Schrader ex Schultes) Nees ex Urban, de la cual se separa por el aquenio. En *B. aspera* (Fig. 1K–M) es oblongo-trígono, de ca. 1.3 mm, atenuado en la base en forma de estípite, las células de la superficie son rectangulares, con la pared tangencial externa convexa, sin protuberancia prominente en el centro; mientras que en *B. hirtella* (Fig. 1N, O) es obcónico-trígono, de ca. 0.75 mm, las células de la superficie son poligonales con las paredes radiales ondeadas y una protuberancia central.

Etimología. El nombre de esta especie alude a la aspereza de todas las partes de la planta.

Paratipos. ARGENTINA. **Corrientes:** Dep. Santo Tomé, Ea. Timbó, *A. Schinini, E. Cabral, S. Cáceres, S. Ferrucci y R. Vanni 23580* (CTES, SI). **Misiones:** Dep. San Ignacio, Colonia Chica, *G. J. Schwarz 5867* (CTES). PARAGUAY. **Amambay:** Parque Nac. Cerro Corá, *F. Mereles 1076* (G). **Caaguazú:** "Prope Caaguazú, in paludosis", *E. Hassler 9102* (G). **Central:** Estero del Ypoá, Villeta-Puerto Guyrati, 7.5 km S of Villeta, Gallery Forest and inundated savanna along creek, on clay, *E. Zardini & L. Guerrero 33857* (MO). **Cordillera:** Cerro Tobati, *I. Basualdo 266* (FCQ). **Paraguarí:** Pirebebuy, Col. Piraretá, *B. Sparre & F. B. Vervoorst 302* (CTES). **San Pedro:** Lima, Ea. Carumbé, *T. M. Pedersen 8512* (CTES).

2. Bulbostylis guaglianoneae M. G. López, sp. nov. TIPO: Argentina. Misiones: dep. Apóstoles, Ruta 14, 10 km al N de San José, 22 ene. 1983, *R. Guaglianone, N. M. Tur, E. P. Carrillo F. 863* (holotipo, SI). Figura 2A–N.

Herba caespitosa, usque 60 cm alta. Folia 25–34 cm, lamina setiformi, vaginae ore ciliato, ciliis caducis. Inflorescentia capitata, conferta, ex ± 50 spicis composita. Spicae 3–7 × 1.3–2 mm. Staminia duo; achaenium 1.25–1.5 × 0.8–1 mm, trigonum, oblongum, transversim lineatum, stylopodio umbonato.

Hierba cespitosa, 60 cm alt.; escapo 57.5 cm × 1–1.5 mm, 17 costillas en transcorte, levemente marcadas, subtriangular a redondeado. Hojas 25–34 cm, ca. 1/2 de la longitud del escapo; lámina setácea, cara adaxial cóncava, bordes escábridos, cara abaxial 6-nervada, nervios suavemente marcados; vaina con el ápice agudo con cilias caducas, pajiza, membranácea. Inflorescencia capitada, densa, ± 50 espiguillas, 1.5–2 cm diám. Espiguillas 3–7 × 1.3–2 mm; glumas caducas, 2.25–2.5 × 2.5–3 mm, rojizas, bordes hialinos, con máculas castañas a ambos lados de la carena, ovoide, aguda, ápice mucronado o mútico, superficie escabrosa, bordes cortamente ciliados. Estambres 2, anteras amarillas, conectivo rojizo, apiculado 0.25 mm, con pelos cortos hialinos en el extremo, filamentos acintados, acrescentes, hialinos con pequeñas máculas rojizas. Estilo dividido desde la 1/2 de su longitud, base engrosada, persistente. Aquenio oblongo-trígono 1.25–1.5 × 0.6–1 mm, atenuado en la base formando un estípite, células de la superficie del aquenio hexagonales, con una protuberancia umbonada en el centro, que en el microscopio estereoscópico se ven como puntos, formando líneas transversales al eje mayor del aquenio; estilopodio umbonado.

Distribución geográfica y ecología. Hasta el momento se la encontró solo en Argentina, Misiones. Crece en bañado ácido.

Discusión. Bulbostylis guaglianoneae es afín a *B. sphaerocephala* (Boeckeler) Lindman. Los caracteres en común son las inflorescencias capitadas y la superficie del aquenio, que está formada por células hexagonales con una protuberancia en el centro. Sin embargo se diferencian porque en *B. guaglianoneae* (Fig. 2L–N) el fruto mide 1.25–1.5 mm, las protuberancias forman líneas transversales al eje mayor del fruto, son umbonadas y el aquenio es oblongo-trígono atenuado en la base formando un estípite, mientras que en *B. sphaerocephala* (Fig. 2O, P) el fruto mide ca. 1 mm, las protuberancias están distribuídas sin formar líneas transversales, son redondeadas y el aquenio es trígono-cónico, con las aristas marcadas, levemente atenuado hacia la base sin formar estípite.

Etimología. El nombre de esta especie está dedicado a la Prof. Rosa Guaglianone, que además de haber coleccionado el ejemplar tipo, debo destacar

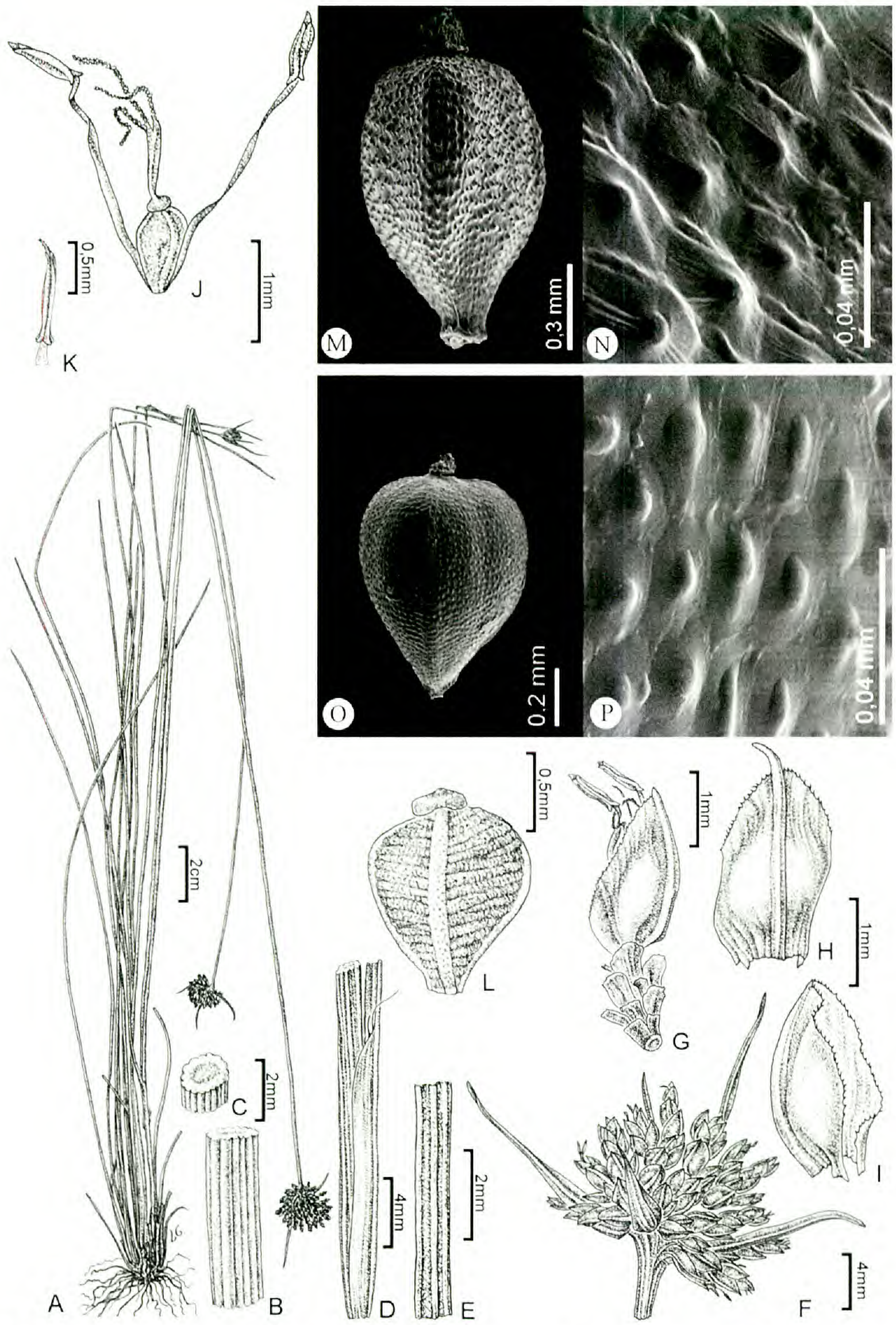

Figura 2. A–N. *Bulbostylis guaglianoneae* M. G. López. —A. Planta. —B, C. Parte del tallo. —D. Vaina. —E. Parte de la lámina foliar, cara abaxial. —F. Inflorescencia. —G. Espiguilla sin las flores inferiores. —H. Gluma vista dorsal. —I. Otra gluma en vista lateral. —J. Flor. —K. Antera. —L. Fruto. M, N. Fotomicrografías de frutos. —M. Fruto entero. —N. Detalle de la superficie (del tipo *Guaglianone et al. 863*, SI). O, P. Fotomicrografías de frutos de *Bulbostylis sphaerocephala*. —O. Fruto entero. —P. Detalle de la superficie del aquenio (*Krapovickas 46167*, CTES).

su constante apoyo y dedicación para el conocimiento de la familia Ciperácea.

3. Bulbostylis subtilis M. G. López, sp. nov. TIPO: Argentina. Misiones: dep. Apóstoles, Ruta 14, 10 km E de San José, 26 feb. 2001, *R. Vanni, B. Marazzi, M. G. López & S. Ferrucci 4596* (holotipo, CTES; isotipos, MO, SI). Figura 3.

Herba caespitosa, 9–15.5 cm alta, glabra. Folia 1–9(–14) cm, lamina filiformi, vagina 10–30 mm, ore ciliato. Inflorescentia antelodium simplex. Spicae 2 ad 3(5), 3–5 mm, 6-ad 7-floriferae. Glumae ovato-naviculares, muticae vel mucronatae. Achaenium ca. 1 × 0.75 mm, trigonum, oboviforme, transversim rugosum, stylopodio plano.

Hierba cespitosa, 9–15.5 cm, forma matas de poco desarrollo, foliosas en la base; escapo 7–14 cm, trígono o subtrígono, verde claro, 7 costillas en transcorte, con algunos pelos cortos en las costillas. Hoja 1–9(–14) × 0.025 cm; lámina 0.5–10(–13) cm, filiforme, verde clara, cara adaxial levemente cóncava, borde escabroso, cara abaxial 3-nervada; vaina 10–30 mm, algunas sin láminas, lineadas longitudi-

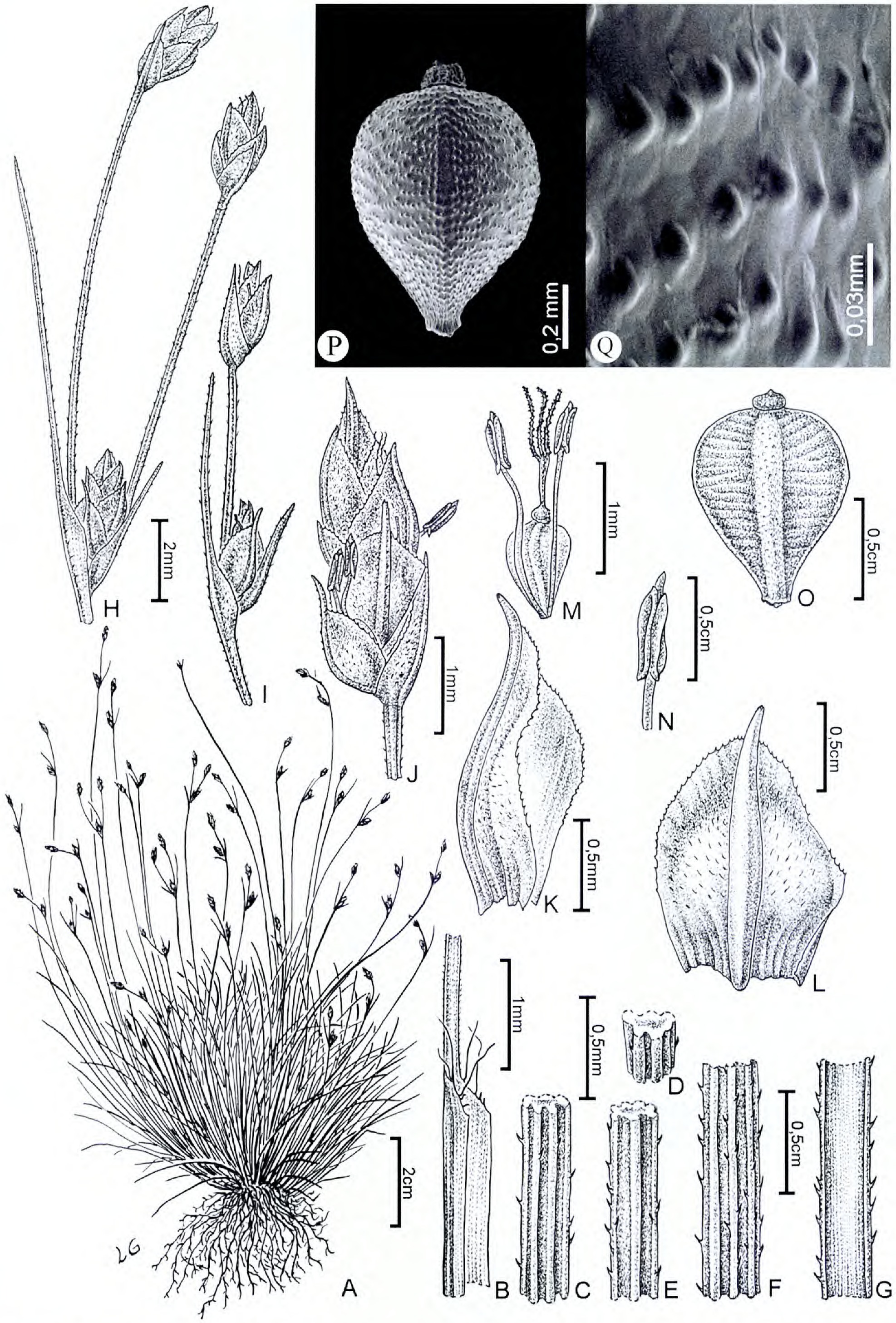

Figura 3. *Bulbostylis subtilis* M. G. López. —A. Planta. —B. Vaina. —C–E. Parte del tallo. F, G. Parte de la lámina foliar. —F. Cara abaxial. —G. Cara adaxial. —H, I. Inflorescencia. —J. Espiguilla. —K. Gluma vista lateral. —L. Otra gluma en vista dorsal. —M. Flor. —N. Antera. —O. Fruto. P, Q. Fotomicrografías de frutos. —P. Fruto entero. —Q. Detalle de la superficie (del tipo *Vanni et al. 4596*, CTES).

nalmente con pelos cortos, hialinos, incurvos, ápice oblicuo con cilias de 1–2 mm; ápice oblícuo con cilias de 1–2 mm; hialinas o verde-amarillenta con algunas células rojizas. Inflorescencia en antelodio simple formada por 2 a 3(5) espiguillas, protegidas por 2 brácteas foliiformes, la inferior (5–)10–12 mm, más larga o igual que la inflorescencia, la superior más corta, ± 3 mm, espiguilla 3–5 mm, 6- a 7-flora, ovoidea-aguda, bráctea de la espiguilla de ca. 1.5 mm, glumácea mucronada, glumas ovado-naviculares, múticas o mucronadas, rojizas, pubescentes, con carena verdosa trinervia y bordes hialinos cortamente ciliados. Flores con 2 estambres y estigma trífido. Aquenio ca. 1 × 0.75 mm, trígono-obovado, blanco amarillento, con manchas grisáceas a lo largo de las aristas, células de la superficie alargadas paralelas al eje longitudinal del fruto, con una protuberancia mamiliforme en el centro, formando ondulaciones transversales (alrededor de 20); estilopodio plano.

Fenología. Florece y fructifica todo el año.

Distribución geográfica y ecología. Habita en el noreste de Argentina, centro-oeste de Bolivia, sudeste de Brasil y Paraguay oriental, crece en campos altos, cerrados de *Butia paraguayensis* (Barbosa Rodrigues) L. H. Bailey y en suelos inundables.

Discusión. Bulbostylis subtilis, se parece a *B. loefgrenii* (Boeckeler) Prata & M. G. López, por el aspecto de la planta y su inflorescencia. Se diferencia porque *B. loefgrenii* tiene 3 estambres y el fruto es de mayor tamaño 1.5 × 0.8–1.2 mm, obovoide, con la superficie suavemente punteada formada por células pentagonales con una protuberancia en el centro, estilopodio castaño, claro, cilindroide (López, 2006).

Etimología. El nombre *Bulbostylis subtilis* alude a la delicadeza de esta planta, por poseer escapos y hojas muy finas.

En Paraguay se la conoce con el nombre vulgar de "espartillo mi" igual que otras especies de *Bulbostylis* y son utilizadas en medicina popular (según observaciones de ejemplares de herbario).

Paratipos. ARGENTINA. **Chaco:** dep. 1° de Mayo, Colonia Benítez, *A. Schulz 642* (CTES). **Corrientes:** dep. Itatí, Ea. Tuyutí, *T. M. Pedersen 10192* (CTES). **Misiones:** dep. Apóstoles, Apóstoles, *R. Martines Crovetto 9412* (BAB); dep. Candelaria, Ruta 12 a 15 km NE de Candelaria, *C. Romanczuk, R. Figueroa Romero, G. Martínez y A. D. Rotman 469* (BAB); dep. Eldorado, 18 km E de Eldorado, sobre Ruta 17, *R. Vanni, B. Marazzi, M. G. López y S. Ferrucci 4548* (CTES); dep. Iguazú, Parque Nac. Iguazú, 8 km E de Pto. de las Canoas, *R. Vanni, S. Ferrucci y M. G. López 2966-B* (CTES). **Salta:** dep. Rosario de la Frontera, Los baños, *S. Venturi 6165* (SI); dep. Santa Victoria, Ruta 40, 5 km de Los Toldos hacia Lipeo, *M. M. Arbo, A. Schinini, N. Loizaga de Castro y M. A. Zapater 9110* (CTES). BOLIVIA. **La Paz:** Murillo Province, Valle del Río Zongo, 39.3 km N (abajo) de la cumbre, *J. C. Solomon 18914* (MO). BRASIL. **São Paulo:** Guaruyá, *T. M. Pedersen 8953* (CTES). PARAGUAY. **Alto Paraná:** Savane Hydromorphe Easse Río Monday, *L. C. Stutz 664* (G); Ea. Santa Elena, Pira Pyta, *A. Schinini & G. Caballero Marmori 27175* (CTES). **Amambay:** "In regione cursus superioris fluminis Apa", *E. Hassler 8366* (G); 2 km de Hernandarias, camino a Salto del Guairá, *A. Schinini y G. Caballero Marmori 27326* (CTES). **Caaguazú:** Cnia. Pindo, camino entre Itaquyry y Curuguati, Estribaciones de la Sra. de San Joaquin, *A. Schinini & G. Caballero Marmori 30181* (CTES). **Misiones:** Ea. "La Soledad", Santiago, *T. M. Pedersen 8668* (CTES, MO). **Paraguarí:** Parque Nac. Ybycuí. Bog 5 km N of admin. bldg. on rd. to César Barrientos, *E. Zardini 8619* (MO, PY).

Agradecimientos. Quiero expresar mi profundo agradecimiento a la Prof. Rosa Guaglianone por la lectura crítica del manuscrito, también al Dr. Javier Fernández Casas por la corrección de la diagnosis en latín y a la señora Liliana Gómez por la realización de las láminas.

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New Combinations in South American *Glandularia* (Verbenaceae)

Nataly O'Leary, María Ema Múlgura, and Osvaldo Morrone
Instituto de Botánica Darwinion, CC 22, Labardén 200, San Isidro (1642), Buenos Aires, Argentina. noleary@darwin.edu.ar; mmulgura@darwin.edu.ar; omorrone@darwin.edu.ar

Abstract. Morphological and karyological features support the transfer of four species from *Verbena* L. to *Glandularia* J. F. Gmelin: *G. balansae* (Briquet) N. O'Leary, *G. paraguariensis* (Moldenke) N. O'Leary, *G. tecticaulis* (Troncoso) N. O'Leary, and *G. thymoides* (Chamisso) N. O'Leary. Nevertheless, this group has features, such as brief style length and the funnelform and short corolla tubes, that are typical of *Verbena*. These four species represent a group informally named Balansae that is interesting from an evolutionary point of view. Two lectotypifications are made for *G. balansae* and *G. thymoides*.

Resumen. Caracteres morfológicos y cariológicos sustentan la transferencia de cuatro especies de *Verbena* L. a *Glandularia* J. F. Gmelin: *G. balansae* (Briquet) N. O'Leary, *G. paraguariensis* (Moldenke) N. O'Leary, *G. tecticaulis* (Troncoso) N. O'Leary y *G. thymoides* (Chamisso) N. O'Leary. Sin embargo este grupo posee caracteres, como el estilo corto y los tubos corolinos breves, infundibuliformes, que son típicos de *Verbena*. Estas cuatro especies representan un grupo ambiguo, evolutivamente interesante, informalmente llamado Balansae. Se introducen dos lectotipificaciones para *G. balansae* y *G. thymoides*.

Key words: *Glandularia*, IUCN Red List, South America, *Verbena*, Verbenaceae.

The genus *Verbena* was described by Linnaeus (1753), and *Glandularia* was later described by J. F. Gmelin (1791 [1792]) with the species *G. carolinensis* J. F. Gmelin. Subsequent authors have included *Glandularia* species within *Verbena* (Schauer, 1847; Bentham & Hooker, 1876; Briquet, 1895; Perry, 1933). Schnack and Covas (1944) studied the chromosome numbers, and both genera were differentiated, the basic chromosome number being $x = 5$ for *Glandularia* and $x = 7$ for *Verbena*. There are also several morphological and anatomical features that differentiate the genera (Schnack & Covas, 1944, 1946; Schnack, 1964; Umber, 1979; Botta, 1989). Most *Glandularia* species have a cylindrical to quadrangular stem with cortical chlorophyllous parenchyma in a continuous band (Botta, 1989: 384, fig. 4A). Inflorescences of *Glandularia* are arranged as a monobotryum or pleiobotryum of one to three florescences, as frondose synflorescences. The mature calyx in *Glandularia* is usually longer than the fruit that it encloses, with five long, sharp-pointed teeth that are connivent and contorted at maturity. The corolla is hypocrateriform (Lindley, 1951: 19), with a long tube, exceeding 7 mm, colored red, violet, blue, lilac, or even yellow. In *Glandularia* the upper anther pair can have glandular appendages on the connective, and thecae always surpass the connective; the style is more than three times the length of the ovary (Fig. 1F–J, Table 1).

In contrast, *Verbena* has a quadrangular stem with cortical chlorophyllous parenchyma in a discontinuous band, interrupted at the corners by bundles of collenchyma and sclerenchyma (Botta, 1989: 384, fig. 4B). The inflorescences in *Verbena* form a pleiobotryum of many florescences, mostly bracteose, arranged in a paniculiform or corymbiform pattern. The mature calyx in *Verbena* is of the same length as the enclosed fruit, with five taper-pointed teeth that are connivent but not contorted at maturity. The corolla is funnelform (Lindley, 1951: 19), with a short tube, generally not exceeding 7 mm, colored pale blue, violet, lilac, or white. The anther connectives have no glandular appendages, and thecae generally do not surpass the connective; the style in *Verbena* is up to three times the length of the ovary (Fig. 1A–E; Table 1).

In the context of the taxonomic revision of *Verbena* (O'Leary et al., 2007; O'Leary et al., in prep.), a morphologically homogenous group of four species, intermediate between *Verbena* and *Glandularia*, herein referred to as the informal group Balansae, was studied, and these species were transferred from *Verbena* to *Glandularia*. These plants grow in northeastern Argentina, eastern Paraguay, Uruguay, and southern Brazil (Moldenke, 1962, 1964; Troncoso, 1968; Troncoso & Bacigalupo, 1982).

Materials and Methods

Voucher specimens and herbaria material analyzed of *Glandularia balansae* (Briquet) N. O'Leary, *G. paraguariensis* (Moldenke) N. O'Leary, *G. tecticaulis* (Troncoso) N. O'Leary, and *G. thymoides* (Chamisso) N. O'Leary were deposited at AS, BA, BAB, BAF, CTES, FCQ, PY, and SI. Given that these four taxa

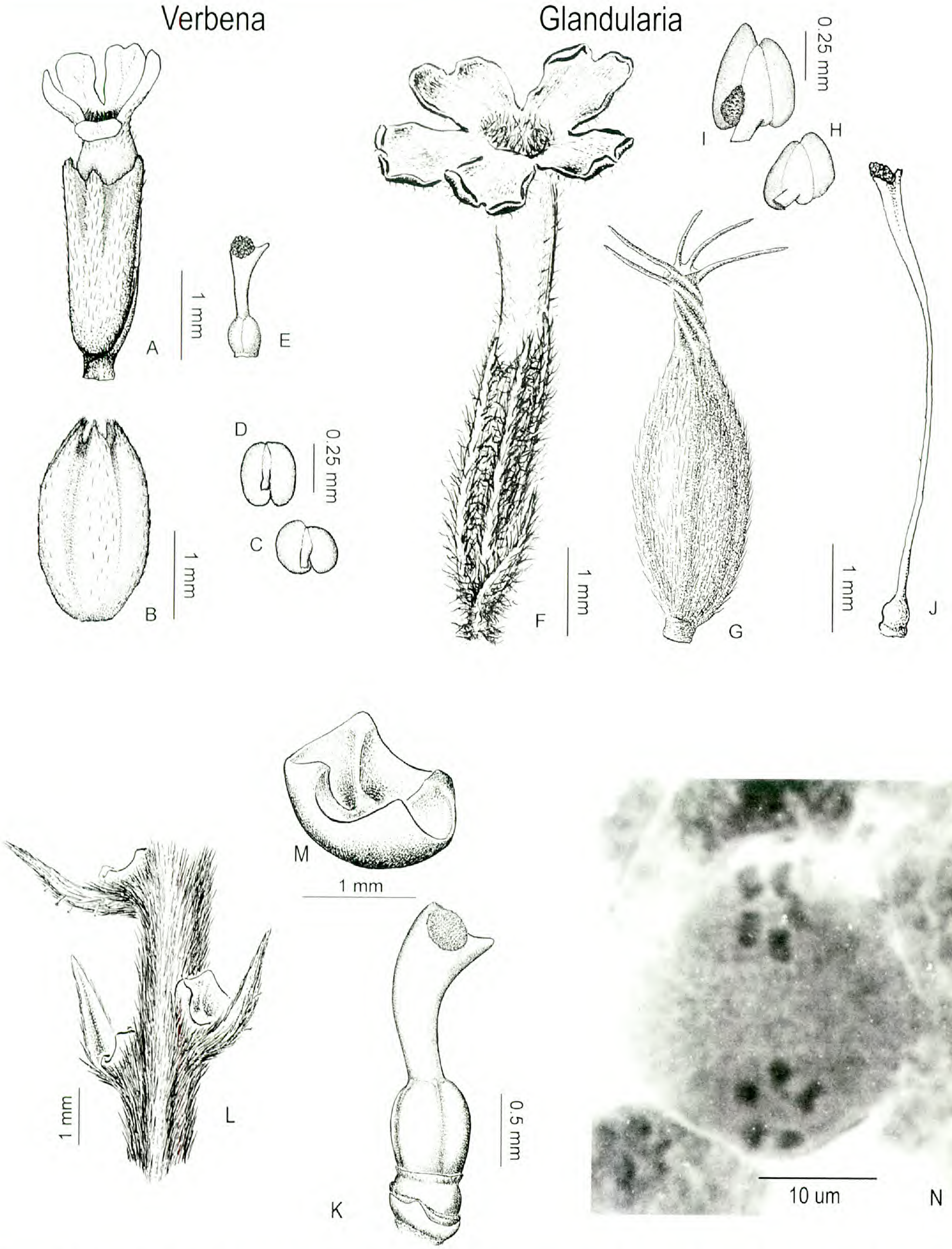

Figure 1. A–E. Typical *Verbena* features. —A. Flower. —B. Calyx enclosing fruit. —C. Lower anther, dorsal view. —D. Upper anther, dorsal view. —E. Gynoecium. (A, drawn from *V. litoralis* Kunth from Troncoso, 1979: 242 by Francisco Rojas; B–E, drawn from *V. montevidensis* Sprengel from Troncoso, 1979: 240 by Francisco Rojas.) F–J. Typical *Glandularia* features. —F. Flower. —G. Calyx enclosing fruit. —H. Lower anther, dorsal view. —I. Upper anther with glandular appendage, dorsal view. —J. Gynoecium. (F, *G. spectabilis* (Moldenke) Botta, from *Cabrera 25575* (SI); G, I, J, drawn from *G. megapotamica* (Sprengler) Cabrera & Dawson, Troncoso, 1979: 255 by Francisco Rojas; H, drawn from *G. cabrerae* (Moldenke) Botta, from Botta & Troncoso, 1993: 108 by Francisco Rojas.) K–M. Floral receptacle in *G. tecticaulis* (Troncoso) N. O'Leary. —K. Young gynoecium, showing undeveloped floral receptacle. —L. Part of a mature florescence, floral bracts and floral receptacles visible. —M. Detail of a developed floral receptacle, showing the four concavities where each nutlet was located. (K–M, from *Schinini & Caballero Marmori 27181*, SI.) —N. *Glandularia thymoides* (Chamisso) N. O'Leary. Microphotograph of meiotic chromosomes in metaphase II, polar view (*R. Guaglianone et al. 3278*, SI).

Table 1. Diagnostic morphological, anatomical, and karyological characters that distinguish *Verbena* from *Glandularia*; also compared to those characters present in group Balansae here analyzed.

	Verbena	Informal group Balansae	*Glandularia*
Stem cross section	quadrangular	cylindrical	cylindrical to quadrangular
Cortical chlorophyllous parenchyma	discontinuous	continuous	continuous
Florescence pattern	pleiobotryum of many florescences, mostly as bracteose synflorescences	monobotryum or pleiobotryum of 1 to 3 florescences, as frondose synflorescences	monobotryum or pleiobotryum of 1 to 3 florescences, as frondose synflorescences
Mature calyx	same length as the fruit, with 5 brief taper-pointed teeth, not contorted	usually longer than the fruit, with 5 long sharp-pointed teeth, contorted	usually longer than the fruit, with 5 long sharp-pointed teeth, contorted
Corolla tubes	funnelform; short; pale blue, violet, lilac, or white	funnelform; short; pale blue, violet, lilac, or yellow	hypocrateriform; long; red, violet, blue, lilac, or yellow
Upper anther pair	without glandular appendages	often with traces of glandular appendages	with or without glandular appendages
Stamens thecae	generally not surpassing the connective	always surpassing the connective	always surpassing the connective
Style	not more than 3× longer than the ovary	not more than 3× longer than the ovary	more than 3× longer than the ovary
Floral receptacle	undeveloped	developed	generally developed
Basic chromosome number	$x = 7$	$x = 5$	$x = 5$

have been poorly collected and that two of them are endemic to Paraguay, chromosomal studies were difficult to carry out, as no fresh samples could be obtained during fieldwork. Just one species, *G. thymoides*, could be karyologically studied. Meiotic material of identical plants from a population of *G. thymoides* from Entre Ríos (*R. Guaglianone et al. 3278*, SI) was collected, and young flower buds were fixed in 3 parts of absolute alcohol: 1 part of glacial acetic acid. The anthers were squashed in a drop of acetic hematoxilin 2% (Núñez, 1968).

Results

The species of the informal group Balansae share a subshrubby habit, strigose pubescence in stems and leaves with scattered glandular hairs, and the floral bracts shorter than the calyx. When mature the calyx disperses with the fruit, leaving a structure behind on the rachis subtended by the floral bract. This structure may be the floral receptacle, which enlarges after anthesis, thickening into a fleshy, yellowish to ochre-colored structure (Fig. 1K–M). The presence of this thick receptacle is a common feature in several *Glandularia* species, as for example, in *G. kuntzeana* (Moldenke) Troncoso and *G. incisa* (Hooker) Troncoso, but has not been seen in any *Verbena* species.

The four species herein transferred to *Glandularia* share many morphological and anatomical features with *Glandularia* (Table 1), i.e., the florescences arranged in a monobotryum or pleiobotryum of one to three florescences, as a frondose synflorescence; the mature calyx exceeding the fruit length, with five long, sharp-pointed teeth that are contorted at maturity; the upper anther pair often with vestigial glandular appendages, the thecae surpassing the connective; and the stems cylindrical, with cortical chlorophyllous parenchyma in a continuous band. Nevertheless, two features are typical of *Verbena*: the short style measuring less than three times the length of the ovary and the funnelform, short corolla tubes, less than 7 mm. These two features were traditionally used by several authors (Schnack & Covas, 1944; Botta, 1989, 1993; Botta & Troncoso, 1993) to discriminate between both genera, but now seem to be unreliable. Because *Glandularia* is characterized by having a basic chromosome number $x = 5$, and *Verbena* $x = 7$ (Schnack & Covas, 1944; Lewis & Oliver, 1961), chromosomal studies were attempted. Just one species, *G. thymoides*, could be karyologically studied, and the results revealed a haploid number $n = 5$ (Fig. 1N) typical of *Glandularia*. These data further suggest that the group Balansae is better placed in *Glandularia*, so these four species are here transferred to *Glandularia*. These four species

represent an interesting group for phylogenetic study toward the evolution of both genera.

Taxonomy of *Glandularia* Group Balansae

1. Glandularia balansae (Briquet) N. O'Leary, comb. nov. Basionym: *Verbena balansae* Briquet, Annuaire Conserv. Jard. Bot. Genève 7–8: 293. 1904. TYPE: Paraguay. Campos Caaguazú, Mar. 1876, *B. Balansa 1028* (lectotype, designated here, G; isotypes, G photo F 24680, K, P, SI). Figure 2.

Subshrubs, to 50 cm, stems and branches erect, decumbent at the base, cylindrical, strigose with scattered glandular hairs, short internodes, less than 1 cm. *Leaves* trisected, linear segments (0.5–)1–2 × 0.02–0.1 cm, or narrowly elliptical, 0.5 cm wide, lateral segments usually bipartite or bisected; sessile, apex acuminate, margins entire, usually revolute, with scattered short hairs, strigose pubescence on both surfaces, venation palmate. *Inflorescences* terminal, to 2–3 cm, ca. 1 cm wide, cylindric-ovoid during anthesis, oblong in fruit, arranged in monobotryum or pleiobotryum of 1 to 3 florescences, as a frondose synflorescence, the principal florescence subsessile, surpassed by the lateral ones. *Flowers* sessile, floral bracts narrowly ovate, (0.2–)0.3–0.4(–0.65) cm, sparsely strigose, glabrous margins; calyx (0.4–)0.5–0.6(–0.8) cm with 5 sharp-pointed teeth, 1 mm, connivent and contorted in fruit, sparsely strigose; corolla funnelform, tube (0.52–)0.65–0.7(–0.82) cm, pale blue or lilac turning white to violet, with moniliform hairs on corolla throat; the upper anther pair with vestigial glandular appendages or none; style 1.5–2 mm. Nutlets 2–2.5 mm, the outer surface reticulate apically to striate basally, the commisural nutlet face verrucose.

Distribution, ecology, and IUCN Red List category. *Glandularia balansae* occurs in northeastern Argentina in the provinces of Misiones and Corrientes, in Brazil in the states of Paraná and Mato Grosso do Sul, and in Paraguay. It inhabits dry fields, in grasslands, but has also been found in flooded areas. According to the current knowledge of the species and using the IUCN Red List categories (IUCN, 2001), *G. balansae* can tentatively be classified as LC (Least Concern).

Notes. *Glandularia balansae* is morphologically similar to *G. thymoides* (see comments under this species).

Typification. Briquet (1904) cited the two syntypes: *Balansa 1163* and *Balansa 1028*. The specimen *Balansa 1163* (Paraguay, Utangú, Villa Rica, Dec. 1874) could not be located, so *Balansa 1028* has been chosen as the lectotype. The material from G was chosen as lectotype because it is in a good state of conservation and it is the herbarium where the author was known to work (Stafleu & Cowan, 1976).

Selected specimens examined. ARGENTINA. **Corrientes:** Dpto. Ituzaingó, ruta 12, *A. Krapovickas 16028* (CTES, SI), ruta 12, ca. A. Itaembé, *M. C. Romanczuk et al. 357* (SI); Dpto. Sto. Tomé, Gob. Virasoro, *A. Cabrera 28420* (SI), Gob. Virasoro, *A. Krapovickas 17113* (CTES, SI), Gob. Virasoro, *A. Schinini & Carnevali 10474* (CTES, SI); Entre Sto. Tomé y Virasoro, *F. Zuloaga et al. 5365* (SI); Ea. Garruchos el duraznillo, *R. Guaglianone et al. 230* (SI); Ao. Chimiray, *A. Krapovickas 26144* (CTES, SI), *C. Cristobal & A. Krapovickas 1751* (CTES, SI). **Misiones:** Dpto. Apóstoles, Esc. Agrotécnica, Co. Ceferino, *A. Cabrera 28700* (SI), *A. Cabrera 29424* (SI), *F. Zuloaga et al. 923* (SI); Dpto. Candelaria, Bonpland, *P. Jörgensen 226* (BAB), Loreto, *M. Múlgura et al. 2237* (SI); Dpto. Capital, Posadas, *R. Martínez Crovetto 8100* (SI). BRAZIL. **Mato Grosso do Sul:** Ponta Porá, *G. Hatschbach 58759* (CTES, SI). **Paraná:** Fazenda Monte Alegre, *G. Hatschbach 2765* (SI); Ponta Grossa, prox. Vila Velha, *L. T. Dombrowski 6327* (SI); Rio Capivara, Mun. Palmeira, *G. Hatschbach 15345* (SI); Mun. Piraí do Sul, Alta da Serra das Furnas, *G. Hatschbach et al. 69903* (CTES). PARAGUAY, s. loc. *P. Jörgensen 4582* (SI), *R. Hauthal 26* (SI), *A. Burkart 18961* (SI). **Amambay:** Ea. San Luis, *A. Schinini et al. 35986* (CTES, PY). **Caaguazú:** Ea. Primera, *T. Rojas 5069* (SI). **Caazapá:** San Juan Nepomuceno, *T. Rojas 5788A* (SI); Dist. Yuty, ca. San Miguel, *M. M. Arbo et al. 2874* (CTES). **Cordillera:** Itacurubi, Ea. Rolón, *T. Rojas 7537* (SI). **Guairá:** Villa Rica, 10 Dec. 1894, s. coll. (BA 23536). **San Pedro:** Ea. Sta. Ana, *I. Basualdo 4855* (FCQ).

2. Glandularia paraguariensis (Moldenke) N. O'Leary, comb. nov. Basionym: *Verbena paraguariensis* Moldenke, Phytologia 1: 483. 1941. TYPE: Paraguay. Sa. de Amambay, Dec. 1907, *E. Hassler 9751* (holotype, G 6700000326; isotypes, BM not seen, G 6700000325, MO, NY). Figure 3.

Subshrubs, to 70 cm, stems and branches erect, cylindrical, strigose with scattered glandular pubescence, short internodes, less than 2 cm. *Leaf* blades entire, narrowly elliptic to linear, ca. 2 × 0.2–0.3 cm, appressed to the stem; sessile, apex acuminate, margins entire, with scattered hairs, strigose pubescence on both surfaces, venation pinnatifid. *Inflorescences* terminal, filiform, to 40 cm, flowers remote, alternately arranged, rachis slender, flexuous, arranged in monobotryum or pleiobotryum of 1 to 3 florescences, as a frondose synflorescence, the principal florescence subsessile, surpassed by the lateral ones. *Flowers* sessile, floral bracts narrowly ovate, 0.2–0.3 cm, sparsely strigose, margins glabrous; calyx ca. 0.6 cm with 5 sharp-pointed teeth, connivent and contorted in fruit, sparsely to densely strigose; corolla funnelform, tube (0.52–)0.65–0.7(–0.82) cm, pale blue, lilac turning white, with moniliform hairs on corolla throat;

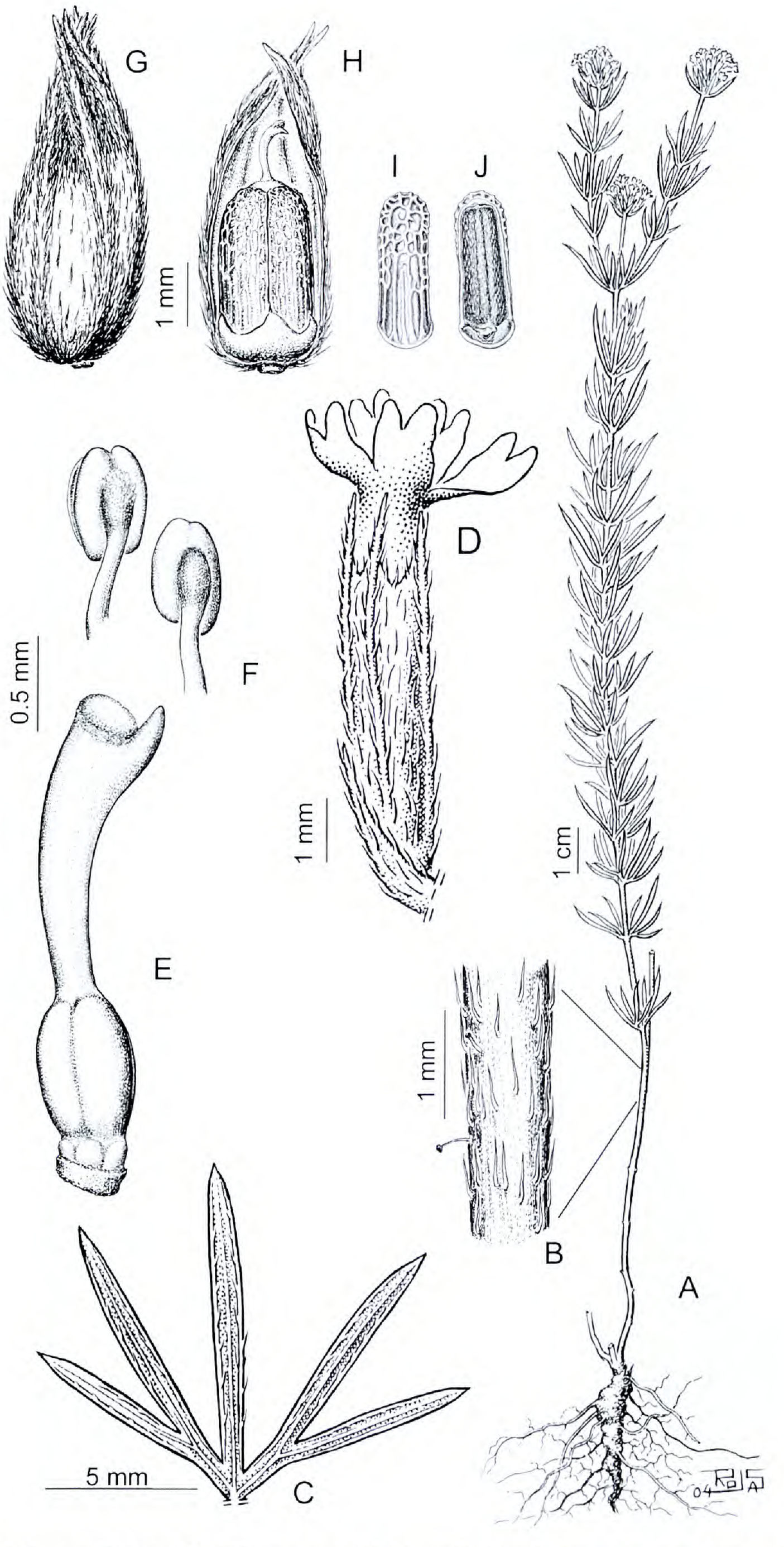

Figure 2. *Glandularia balansae* (Briquet) N. O'Leary. —A. Habit. —B. Detail of stem pubescence. —C. Abaxial face of leaf. —D. Flower. —E. Gynoecium. —F. Upper pair of anthers. —G. Calyx enclosing fruit. —H. Same as G but part of the calyx removed, showing the fruit. —I. Nutlet, dorsal view. —J. Nutlet, ventral view. (A, C–F, from *Rojas 7537*; B, G–J, from *Schinini & Carnevali 10474*).

the upper anther pair with vestigial glandular appendages; style 1.5–2 mm. Nutlets 2.5–3 mm, the outer surface reticulate apically to striate basally, the commisural nutlet face verrucose.

Distribution, ecology, and IUCN Red List category. *Glandularia paraguariensis* is endemic to Paraguay in the Sierras of Amambay. This species is quite undercollected and is known so far only from the specimens

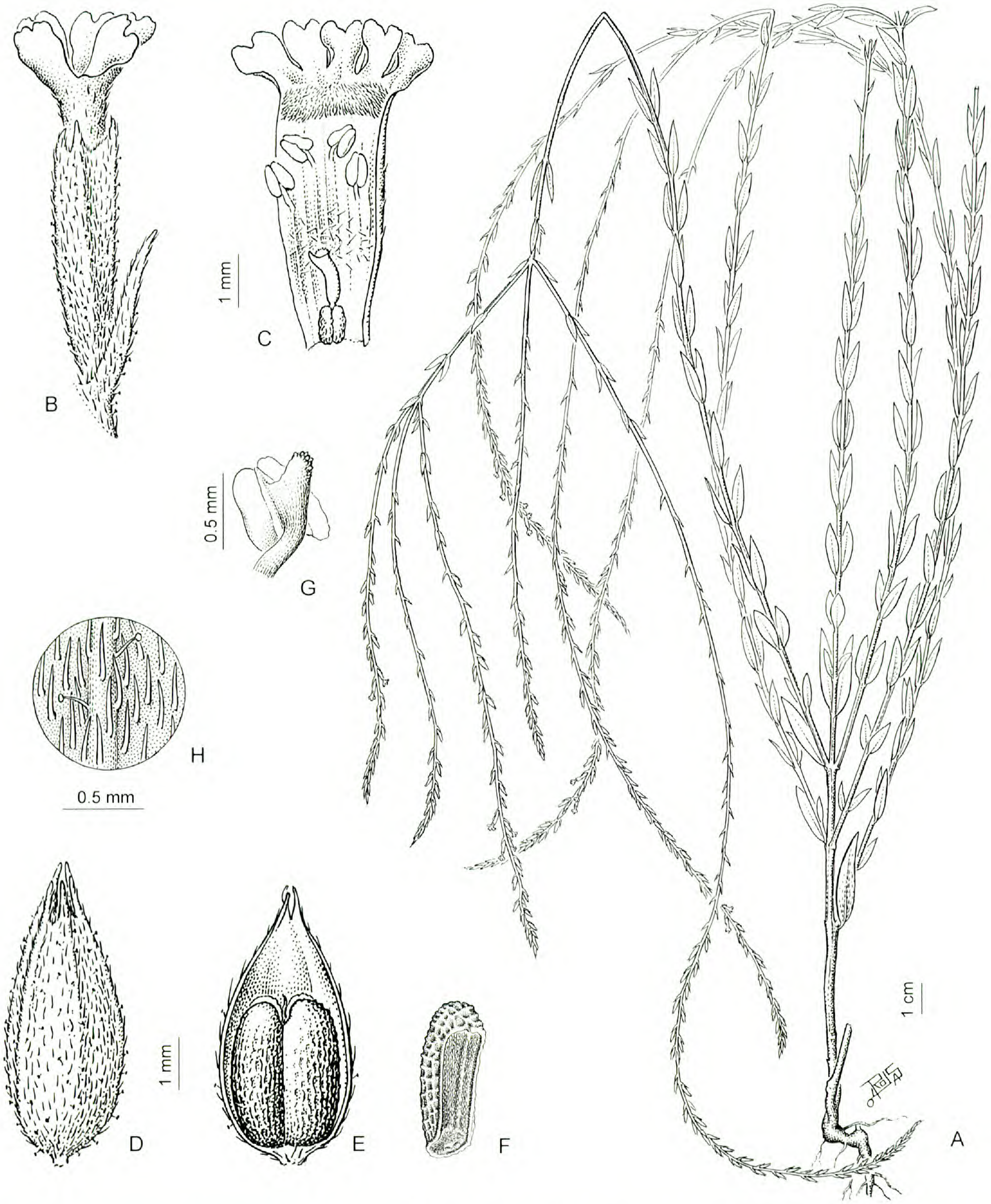

Figure 3. *Glandularia paraguariensis* (Moldenke) N. O'Leary. —A. Habit. —B. Flower. —C. Open corolla showing position of anthers and gynoecium. —D. Calyx enclosing fruit. —E. Same as D but part of the calyx removed, showing the fruit. —F. Nutlet. —G. Upper anther with glandular appendage. —H. Detail of abaxial leaf pubescence (from *Rojas 6586*, SI).

cited herein. Based on this evidence, following the IUCN Red List categories (IUCN, 2001), we evaluate the provisional conservation status of this species as DD (Data Deficient). We hope that this publication will contribute to a better knowledge of this species, and that future surveys could reveal further information.

Notes. *Glandularia paraguariensis* can be easily distinguished from the other three species of group Balansae by its long, filiform florescences, which are shorter and denser in *G. balansae*, *G. thymoides*, and *G. tecticaulis*. Moreover, *G. paraguariensis* has the leaf blades entire, being partitioned in the other three species.

Briquet (in sched.) named the specimen *Hassler 9751* (G) as *Verbena balansae* var. *integrifolia*, but never published this name. Later, Moldenke (1941) chose this specimen as type for his species *V. paraguariensis*.

Selected specimen examined. PARAGUAY. **Amambay:** Pedro Juan Caballero, Jan. 1934, *T. Rojas 6586* (SI).

3. Glandularia tecticaulis (Troncoso) N. O'Leary, comb. nov. Basionym: *Verbena tecticaulis* Troncoso, Darwiniana 14: 633. 1968. TYPE: Paraguay. "Curso superior del Paraná," 1909–1910, *K. Fiebrig 5837bis* (holotype, SI).

Subshrubs, to 50 cm, stems and branches erect, cylindrical, strigose with scattered glandular pubescence, short internodes 1–2 cm. *Leaves* appressed to the stem, ca. 1.5 × 0.8 cm, ovate, rounded base, trilobate to tripartite apex, with each lobe triangular, acuminate, margins entire, revolute, with strigose pubescence on both surfaces, venation palmate, subparallel and converging toward base. *Inflorescences* terminal, cylindric-ovoid during anthesis, turning oblong in fruit, each florescence brief and wide, elongating to 2 cm, arranged in monobotryum or pleiobotryum of 1 to 3 florescences, as a frondose synflorescence, the principal florescence subsessile, surpassed by lateral ones. *Flowers* sessile, floral bracts narrowly ovate, ca. 0.4 cm, sparsely strigose, margins glabrous; calyx ca. 0.6 cm, with 5 sharp-pointed teeth, connivent and contorted in fruit, sparsely to densely strigose, sometimes glandular hairs; corolla funnelform, tube 0.6 cm, pale blue, lilac to yellow, with moniliform hairs on corolla throat; the upper anther pair with vestigial glandular appendages or none; style 1.5–2 mm. Nutlets 2–2.5 mm, the outer surface reticulate apically to striate basally, the commisural nutlet face verrucose.

Iconography. N. S. Troncoso, 1968: 634, fig. 2.

Distribution, ecology, and IUCN Red List category. *Glandularia tecticaulis* is endemic to Paraguay, Alto Paraná department. It grows in dry fields surrounded by small shrubs, in cerrado regions. This species appears to be a very localized endemic, with small populations known, and consequently poorly collected. A preliminary status of VU (Vulnerable) can be assigned to the species, following IUCN Red List categories (IUCN, 2001).

Notes. This species is easily distinguished due to the trilobate or tripartite leaves, appressed to the stem, while in *Glandularia balansae* and *G. thymoides* leaves are trisected and never appressed to the stem. The specimen label for *Degen 247* (CTES, FCQ) indicates yellow flowers. Troncoso (1968), in the protologue of this species, states that this taxon represents an interesting case in the delimitation of *Verbena* and *Glandularia*, because it has features of both genera.

Selected specimens examined. PARAGUAY. **Alto Paraná:** Ea. Sta. Elena, río Pirá Pytá, 16 Oct. 1990, *G. Caballero Marmori s.n.*, Hb. Itaipú 1802 (CTES); Hernandarias, *A. Schinini 8061* (CTES); Ea. Sta. Elena, río Pirá Pytá, *A. Schinini & G. Caballero Marmori 27181* (CTES, G, SI); reserva Tatí Yupí, *G. Caballero Marmori 538* (CTES), *R. Degen 247* (CTES, FCQ), *A. Schinini & G. Caballero Marmori 26921* (CTES, G).

4. Glandularia thymoides (Chamisso) N. O'Leary, comb. nov. Basionym: *Verbena thymoides* Chamisso, Linnaea 7: 257. 1832. TYPE: [Brazil.] Brasilia, *Sellow s.n.* (lectotype, designated here, K; isotypes, BR, G, K, M, NY, SI).

Verbena thymoides f. *albiflora* Moldenke, Phytologia 3(4): 178. 1949. Syn. nov. TYPE: Uruguay. Dpto. Minas [Lavalleja]: Cerro Nico Perez y Sa. Tapambay, Nov.–Dec. 1892, *J. Arechavaleta 11/1982* (holotype, MVM not seen; isotype, NY).

Subshrubs, to 20–30 cm, stems and branches decumbent to procumbent at the base, cylindrical, strigose pubescence, short internodes, less than 1 cm. *Leaves* trisected, linear segments or narrowly elliptical, to 1 cm, lateral segments usually bipartite or bisected; sessile, apex acuminate, margins entire, usually revolute with scattered short hairs, strigose pubescence on both surfaces, venation palmate. *Inflorescences* terminal, to 2–3 cm, ca. 1 cm wide, cylindric-ovoid during anthesis, oblong in fruit, arranged in monobotryum or pleiobotryum of 1 to 3 florescences, as a frondose synflorescence, the principal florescence subsessile, surpassed by lateral ones. *Flowers* sessile, floral bracts narrowly ovate, (0.18–)0.2–0.22(–0.28) cm, sparsely strigose, glabrous margins; calyx (0.3–)0.4(–0.45) cm with 5 sharp-pointed teeth, connivent and contorted in fruit, sparsely strigose; corolla funnelform, tube (0.4–)0.5–0.55(–0.65) cm, pale blue, lilac turning white, to violet, with moniliform hairs on corolla throat; the upper anther pair with vestigial glandular appendages; style 2–2.5 mm. Nutlets ca. 2 mm, the outer surface reticulate apically to striate basally, the commisural nutlet face verrucose.

Chromosome number. $n = 5$ ($x = 5$). Figure 1N.

Iconography. N. S. Troncoso & N. Bacigalupo, 1982: 486, fig. 4.

Distribution, ecology, and IUCN Red List category. *Glandularia thymoides* occurs in Argentina in the province of Entre Ríos, in southern Brazil in the states of Río Grande do Sul, Santa Catarina, and

Paraná, and in Uruguay. It is found in dry fields, somewhat rocky or sandy soils, generally among grasses. According to the current knowledge of the species and using the IUCN Red List categories (IUCN, 2001), *G. thymoides* can tentatively be classified as LC (Least Concern).

Notes. *Glandularia thymoides* is morphologically very similar to *G. balansae* in its leaf blades being trisected, with segments linear or narrowly elliptical, and cylindric-ovoid florescences. Troncoso and Bacigalupo (1982) distinguish both species by the length of the leaves, the presence or absence of vestigial glandular appendages on the anthers, and the comparative length of the floral bracts, calyx, and style, as explained in the key. *Glandularia balansae* has a different habit, being more erect, while *G. thymoides* is prostrate. Finally, *G. balansae* grows in Paraguay and northeastern Argentina, in Misiones and Corrientes provinces, while *G. thymoides* is found to the south and east, reaching Uruguay and the Argentine province of Entre Ríos. Both taxa coexist in southern Brazil (Moldenke, 1962; Troncoso & Bacigalupo, 1982). This distribution could indicate that *G. balansae* is associated with the Paraná river course, while *G. thymoides* is associated with the Uruguay river course.

The name *Verbena thymoides* was used later by J. Ball (1890) to describe a taxon from Chile that is now recognized as a species of *Junellia* Moldenke, so Ball's name is illegitimate (Art. 52.1; Greuter et al., 2000).

Moldenke considered that the color of the flowers constituted an important character that should have taxonomic relevance. However, given that these species show quite variable flower colors, his form *albiflora* should not be recognized as an infraspecific taxon within *Verbena thymoides* [= *Glandularia thymoides*].

Typification. The photograph from the Field Museum number 17454 of the destroyed holotype from the Berlin herbarium had a label that read: "*Verbena thymoides n.* Bras. merid., *Sellow*" and another label with the number "1482," even though the protologue of this species indicated no number for the Sellow collection. In K there are two specimens that could be isotypes of the destroyed Berlin holotype, since both bear a label: "*Verbena thymoides n.*" typical of Chamisso's new taxa. The specimen chosen as the lectotype has a stamp that reads "15 nov. 1907"; this date is an obvious later addition to the specimen, and the specimen is chosen because it includes more material of better quality. The isotypes at BR and NY are "ex B," as indicated by their labels; the specimens from M and G are also original and representative isotypes, but the one from K was selected because it is a more complete specimen.

Selected specimens examined. ARGENTINA. **Entre Ríos:** Dpto. Concordia, Calabacilla, ca. Nueva Escocia, *R. Guaglianone et al. 3278* (SI), camino a Calabacilla, Pto. Yeruá, *N. Troncoso 2822* (SI). BRAZIL. **Paraná:** Palmeira, corrego da anta, 2 Feb. 1975, *T. Pedersen s.n.* (CTES 354603); Lapa, *L. T. Dombrowski 6756* (SI); Sta. Barbara, mun. Palmas, *G. Hatschbach 15013* (SI); Rio Passa 2, mun. Lapa, *G. Hatschbach 22310* (SI). **Rio Grande do Sul:** Torres, Butiazal, *K. Hagelund 15027* (CTES); Fachinal Preto, Bom Jesus, *R. Reitz 3312* (SI); Serra do Merval ca. Pinheiro Machado, *G. Pabst 6515* (SI); Cacapava do sul, *K. Hagelund 11731* (CTES, SI); Arroio dos Ratos, Faxinal, *T. Pedersen 12619* (CTES, SI); Serinha Dom Pedrito, *M. Sobral 1543* (SI). **Sta. Catarina:** Sombrío, *B. Rambo 32003* (SI), *R. Reitz c1062* (SI); Curralinhos, Araranguá, *R. Reitz c883* (SI). URUGUAY. **Co. Largo:** Sa. Aceguá, *B. Rosengurtt 1001* (SI). **Maldonado:** Blno. Solis, *A. Burkart 12680* (SI); Sa. Ánimas, Solís, *C. Osten 11638* (BAF). **Rivera:** Zapucay, *A. Flossdorf 98* (BAF). **Tacuarembó:** Valle Edén, *W. Herter 3920* (SI), *C. Osten 6594* (SI).

KEY TO THE *GLANDULARIA* SPECIES GROUP BALANSAE

1a. Blades entire; florescences long, to 40 cm in fruit, filiform; flowers remote . . . . . *G. paraguariensis*
1b. Blades trilobate, tripartite, or trisected; florescences short, to 2–3 cm in fruit, not filiform; flowers congested 2
2a. Leaves appressed to the stem, this scarcely visible; blades trilobate to tripartite at the apex . . . . . *G. tecticaulis*
2b. Leaves not appressed to the stem, this easily visible; blades trisected, segments linear to narrowly elliptical, lateral segments usually bipartite or bisected 3
3a. Erect plants; leaves (0.5–)1–2 cm long; usually no glandular appendages on upper anther pair; style 1.5–2 mm long; floral bracts (0.2–)0.3–0.4(–0.65) cm long; calyx (0.4–)0.5–0.6(–0.8) cm long; corolla tube (0.52–)0.65–0.7(–0.82) cm long . . . . . *G. balansae*
3b. Prostrate plants; leaves to 1 cm long; presence of vestigial glandular appendages on upper anther pair; style 2–2.5 mm long; floral bracts (0.18–)0.2–0.22(–0.28) cm long; calyx (0.3–)0.4(–0.45) cm long; corolla tube (0.4–)0.5–0.55(–0.65) cm long . . . . . *G. thymoides*

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Two New Species of *Saxifraga* (Saxifragaceae) from Southwestern China

Pan Jin-Tang†, *Mei Li-juan*, *Zhang De-jun*, *and Chen Shi-long*

Key Laboratory of Adaptation and Evolution of Plateau Biota, Northwest Institute of Plateau Biology, Chinese Academy of Sciences, Xining 810008, People's Republic of China. Author for correspondence: slchen@nwipb.ac.cn

Abstract. Two new species, *Saxifraga xiaozhongdianensis* J. T. Pan and *S. ludingensis* J. T. Pan, from the Saxifragaceae in China are described and illustrated. Of these, *S. xiaozhongdianensis* is endemic to Zhongdian, Yunnan, and is related to *S. brachyphylla* Franchet. It differs from *S. brachyphylla* in the sepals adaxially dark brown glandular-villose and the petals basally subauriculate. *Saxifraga ludingensis* occurs in Luding, Sichuan, and is very similar to *S. egregioides* J. T. Pan and *S. stellariifolia* Franchet. It differs from *S. egregioides* in the stems brown glandular-villose, the cauline leaves adaxially brown glandular-villose, the sepals spreading in anthesis and abaxially brown glandular-villose, and the petals 5-veined. It differs from *S. stellariifolia* in the leaves cordate and abaxially glabrous, the sepals abaxially brown glandular-villose, and the petals 4-callose and 5-veined. *Saxifraga xiaozhongdianensis* and *S. ludingensis* are apparently endemic to western China and belong to *Saxifraga* sect. *Ciliatae* Haworth, emend. J. T. Pan.

Key words: China, IUCN Red List, *Saxifraga*, Saxifragaceae, Sichuan, Yunnan.

From 2002 to 2003, a large number of specimens of the genus *Saxifraga* L. (Saxifragaceae) were collected from Qinghai, Sichuan, Yunnan, and Xizang provinces in China. Later, these specimens were all determined based on the literature (Pan, 1978, 1990, 1991, 1992; Wu & Pan, 1990; Pan et al., 2001), and new species were discovered. Of them, *S. xiaozhongdianensis* J. T. Pan and *S. ludingensis* J. T. Pan are newly described as follows.

1. Saxifraga xiaozhongdianensis J. T. Pan, sp. nov. TYPE: China. Yunnan: Xiaozhongdian, 27°34′24″N, 99°48′20″E, in shrub, 3260 m, 7 Oct. 2003, *S. L. Chen 03168* (holotype, HNWP). Figure 1.

Species *Saxifragae brachyphyllae* Franchet proxima, a qua sepalis adaxialiter nigro-brunnescenter-glanduloso-pilosis, petalis basi subauriculatis dignoscenda.

Herb perennial, caespitose, 14–17 cm tall; stem proximally brown crisped glandular-villous, distally dark brown glandular-villose. Basal leaves with petiole ca. 8 mm and marginally brown crisped villous, leaf blade rhomboid-elliptic, ca. 6.2 × 3.6 mm, glabrous, apex subobtuse; cauline leaves with petiole gradually shorter to subsessile distally on stem, 0.1–1 mm, abaxially and marginally brown glandular-villous, proximal ones denser, elliptic or ovate to narrowly ovate, 2.1–7.3 × 1.1–3 mm, glabrous toward margin or brown glandular-villous at basal margin, apex obtuse or subacuminate, distal ones more lax, lanceolate, 5–6.5 × 1.4–2 mm, adaxially glandular-villose, abaxially glabous, marginally ± glandular-villose, apex obtuse or subacuminate. Cyme 4–4.3 cm, 3- to 6-flowered; pedicels 0.3–1.2 cm, dark brown glandular-villose. Flower with sepals reflexed in anthesis, ovate, 2.6–3 × 1.6–2.6 mm, both surfaces marginally dark brown glandular-villose, veins 3, not confluent at apex, apex obtuse; petals yellow, oblong, 6–7 × 2–3 mm, 4-callose, 3- to 5-veined, base subauriculate, contracted into a claw 0.5–0.8 mm, apex obtuse; stamens 3–3.5 mm, filaments subulate; ovary superior, ovoid, 2–2.2 mm, styles 1–1.2 mm.

Phenology. Flowering and fruiting July–October.

Relationships. Saxifraga xiaozhongdianensis is related to *S. brachyphylla* in having its stems proximally brown crisped glandular-villous and distally brown glandular-villose; its distal cauline leaves lax and lanceolate; its sepals reflexed in anthesis, ovate with three veins, not confluent at apex; and its petals yellow, oblong, and 4-callose. The new species differs by its sepals adaxially dark brown glandular-villose and petals basally subauriculate (vs. sepals dark brown glandular-villose abaxially and sparsely so at distal margin with petals base contracted into a claw in *S. brachyphylla*).

Distribution, habitat, and IUCN Red List category. Saxifraga xiaozhongdianensis is known from the type locality at an elevation of 3260 m, inhabiting alpine scrub meadow in Zhongdian County, Yunnan Province, China. Due to the rarity and limited distribution of *S. xiaozhongdianensis*, this species should be included in the endangered category of the IUCN Red List according to the following criteria (IUCN, 2001): EN Blab (i, ii, iii).

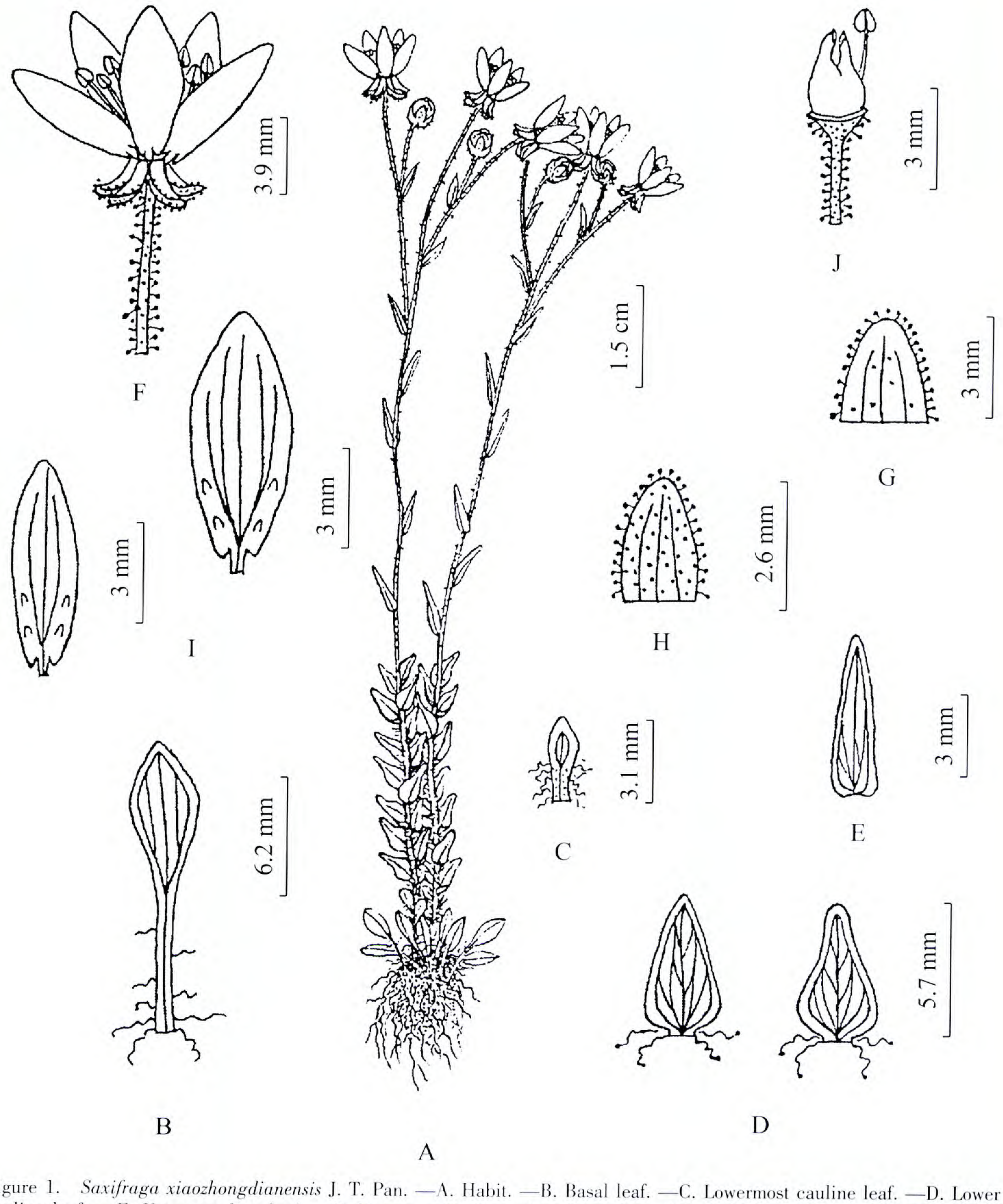

Figure 1. *Saxifraga xiaozhongdianensis* J. T. Pan. —A. Habit. —B. Basal leaf. —C. Lowermost cauline leaf. —D. Lower cauline leaf. —E. Upper cauline leaf. —F. Flower. —G. Ventral surface of sepal. —H. Back of sepal. —I. Petals. —J. Pedicel, stamen, and pistil. Drawn by J. T. Pan from the holotype (*S. L. Chen 03168*, HNWP).

2. Saxifraga ludingensis J. T. Pan, sp. nov. TYPE: China. Sichuan: Luding, 29°33′98″N, 101°58′78″E, under forest, 3200 m, 13 Sep. 2003, *S. L. Chen 03096* (holotype, HNWP). Figure 2.

Species *Saxifragae egregioidi* J. T. Pan et *S. stellariifoliae* Franchet persimilis, sed a priore caule imprimis brunneo-glandulosim-piloso in illa glabro, foliis adaxialiter brunneo-glandulosim-pilosis in illa glabris, sepalis sub anthesi patentibus (in illa reflexis), abaxialiter glanduloso-pilosis (in illa glabris), petalis 5-nervibus, a posteriore foliis basi cordatis et abaxialiter glabris (in *S. stellariifolia* basi rotundatis et abaxialiter sparse glanduloso-pilosis), sepalis abaxialiter brunneo-glandulosim-pilosis (in *S. stellariifolia* glabris), petalis 4-callosis et 5-nervibus (in *S. stellariifolia* 4- ad 6-callosis et 3- ad 5-nervibus) recedit.

Herb perennial, ca. 20 cm tall. Stem slender, brown glandular-villose. Cauline leaves with petiole 3.5–8 mm, gradually shorter toward apex of stem, brown

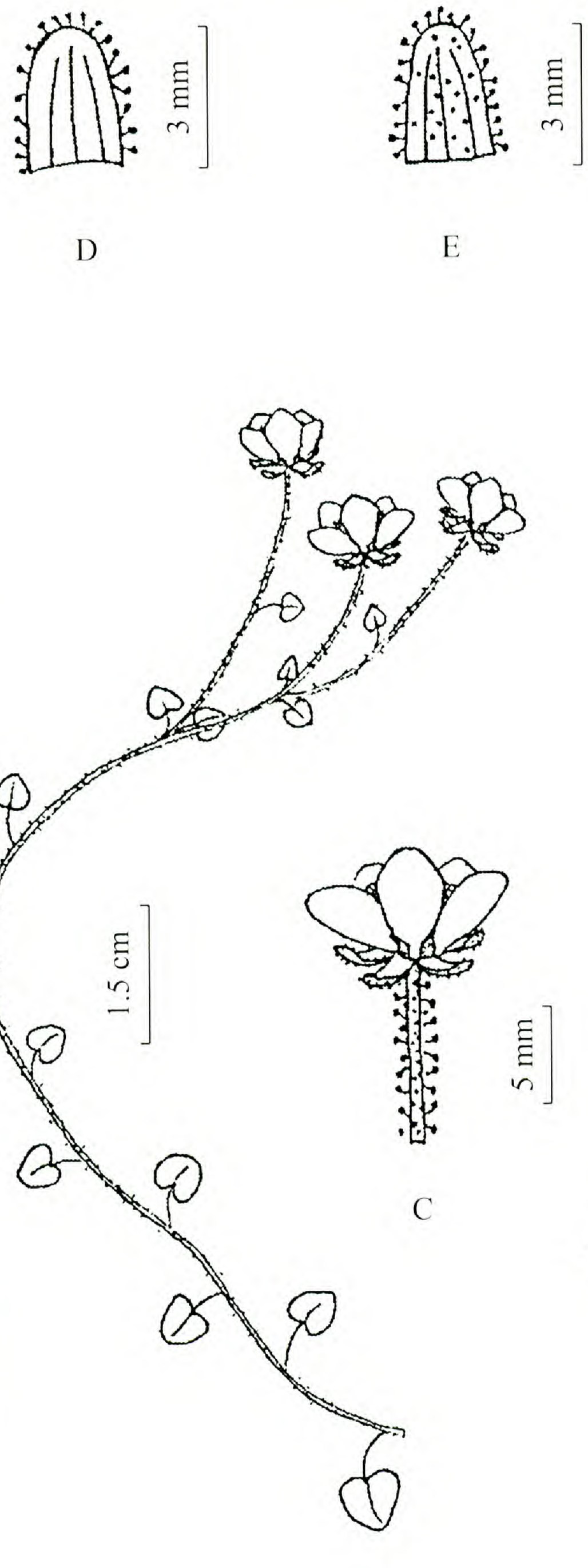

Figure 2. *Saxifraga ludingensis* J. T. Pan. —A. Part of plant. —B. Leaf. —C. Flower. —D. Ventral surface of sepal. —E. Back of sepal. —F. Petal. —G. Pedicel, stamen, and pistil. Drawn by J. T. Pan from the holotype (*S. L. Chen 03168*, HNWP).

glandular-villous, leaf blade cordate, 4–6 × 4–6 mm, adaxially and marginally brown glandular-villose, abaxially glabrous, apex acute or obtuse. Flower solitary or in 3-flowered cyme; pedicels 1.5–2.1 cm, brown glandular-villose. Flower with sepals spreading in anthesis, ovate, 3–3.3 × ca. 2 mm, adaxially glabrous, abaxially and marginally brown glandular-villose, veins 3, not confluent at apex, apex obtuse; petals yellow, obovate, broadly obovate to broadly elliptic, 5–5.3 × 3–4 mm, 4-callose, 5-veined, base contracted into a narrow claw 0.8–1 mm, apex obtuse or rotund; stamens ca. 4.5 mm, filaments

subulate; ovary superior, ovoid, ca. 3 mm, styles 2, ca. 1 mm.

Phenology. Flowering July–September.

Relationships. *Saxifraga ludingensis* is similar to *S. egregioides* and *S. stellariifolia* in its slender stems, cauline leaves petiolate, leaf blades marginally glandular-villose, and sepals with veins not confluent at apex. The new species differs from *S. egregioides* by its stems glandular-villose, cauline leaves with the blade adaxially brown glandular-villose, sepals spreading in anthesis and abaxially brown glandular-villose, and 5-veined petals. In *S. egregioides*, the stems are distally glabrous, the leaf blades are glabrous adaxially and abaxially, the sepals are reflexed and glabrous adaxially and abaxially, and the petals are 4- to 6-veined. *Saxifraga ludingensis* is readily distinguished from *S. stellariifolia* by its cauline leaves with leaf blade cordate and abaxially glabrous, sepals abaxially brown glandular-villose, and petals obovate, broadly obovate to broad-elliptic, 4-callose, and 5-veined. In *S. stellariifolia*, the cauline leaves are ovate and abaxially glandular-villose, the sepals are glabrous adaxially and abaxially, and the petals are ovate to elliptic, 4- to 6-callose, and 3- to 5-veined.

Distribution, habitat, and IUCN Red List category. *Saxifraga ludingensis* was collected at an elevation of 3200 m, under the forest canopy in Luding County, Sichuan Province, China. Due to the rarity and limited distribution of *S. ludingensis*, the species should be included in the endangered category of the IUCN Red List according to the following criteria (IUCN, 2001): EN Blab (i, ii, iii).

Both *Saxifraga xiaozhongdianensis* and *S. ludingensis* are assigned to section *Ciliatae* Haworth, emend. J. T. Pan (1991), which is characterized by features such as plants forming erect, caespitose clumps, cushions, or sprawling mats and lacking basal bulbils; the flowering stems are usually leafy; the inflorescence is cymose or the flower is solitary; flowers are sometimes unisexual, actinomorphic, and 5-merous; the petals are usually yellow or orange, occasionally white, pink, or red, sometimes spotted orange, red, or purple, very often with callosities; the ovary is superior to subinferior; and there are two integuments in the seed.

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New Combinations and Names in *Peponidium* and *Pyrostria* (Rubiaceae, Vanguerieae)

Sylvain G. Razafimandimbison

Bergius Foundation, Royal Swedish Academy of Sciences, and Botany Department, Stockholm University, SE-10691, Stockholm, Sweden.
Author for correspondence: sylvain.razafimandimbison@bergianska.se

Henrik Lantz

Systematic Botany Department, Uppsala University, SE-75236, Uppsala, Sweden.
henrik.lantz@ebc.uu.se

Birgitta Bremer

Bergius Foundation, Royal Swedish Academy of Sciences, and Botany Department, Stockholm University, SE-10691, Stockholm, Sweden. birgitta.bremer@bergianska.se

Abstract. The newly circumscribed dioecious group (sensu Razafimandimbison et al.) of tribe Vanguerieae in the subfamily Ixoroideae (Rubiaceae) comprises over 200 species classified in four morphologically distinct genera: *Cyclophyllum* Hooker f., *Peponidium* (Baillon) Arènes, *Pyrostria* Commerson ex Jussieu, and one new genus affined to species of *Canthium* subg. *Bullockia* Bridson. Here, we present a total of 37 new combinations, 20 of which are in *Peponidium*: *P. alleizettei* (Dubard & Dop) Razafimandimbison, Lantz & B. Bremer, *P. andringitrense* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. ankaranense* (Arènes ex Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. anoveanum* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. arenesianum* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. blepharodon* (Arènes ex Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. boinense* (Arènes ex Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. bosseri* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. buxifolium* (Baker) Razafimandimbison, Lantz & B. Bremer (lectotypified here), *P. cystiporon* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. decaryi* (Homolle ex Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. humbertianum* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. latiflorum* (Homolle ex Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. mandrarense* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. marojejyense* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. sahafaryense* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. subevenium* (K. Schumann) Razafimandimbison, Lantz & B. Bremer, *P. tamatavense* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. venulosum* (Boivin ex Baillon) Razafimandimbison, Lantz & B. Bremer, and *P. viguieri* (Homolle ex Cavaco) Razafimandimbison, Lantz & B. Bremer. The other 17 new combinations are in *Pyrostria*: *P. ambongensis* (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, *P. ampijoroensis* (Arènes) Razafimandimbison, Lantz & B. Bremer, *P. ankaranensis* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. antsalovensis* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. asosa* (Arènes) Razafimandimbison, Lantz & B. Bremer, *P. capuronii* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. ixorifolia* (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, *P. longiflora* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. neriifolia* (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, *P. oleifolia* (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, *P. perrieri* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. revoluta* (Balfour f.) Razafimandimbison, Lantz & B. Bremer, *P. richardiae* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. sambavensis* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. suarezensis* (Cavaco) Razafimandimbison, Lantz & B. Bremer, *P. tulearensis* (Cavaco) Razafimandimbison, Lantz & B. Bremer, and *P. verdcourtii* (Cavaco) Razafimandimbison, Lantz & B. Bremer. Finally, three new names, *Peponidium sakalavense* Razafimandimbison, Lantz & B. Bremer, *Pyrostria antsirananensis* Razafimandimbison, Lantz & B. Bremer, and *Pyrostria louvelii* Razafimandimbison, Lantz & B. Bremer, are published here.

Key words: *Peponidium*, *Pyrostria*, Rubiaceae, Vanguerieae.

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Recent molecular phylogenetic studies have been conducted by Razafimandimbison et al. (in press) based on sequence data from the nuclear external and internal transcribed spacer regions and the chloroplast *trnT-F* region. This work supports the establishment of largely new generic circumscriptions for the mostly dioecious group of the Paleotropical tribe Vanguerieae in the subfamily Ixoroideae s.l. (Rubiaceae). The dioecious group sensu Razafimandimbison et al. (in press) presently contains over 200 species classified in four morphologically distinct genera: an Afro-Malagasy new genus affined to the species of *Canthium* subg. *Bullockia* Bridson (Bridson, 1987), the Pacific and Australian *Cyclophyllum* Hooker f., the Malagasy-Comorian *Peponidium* (Baillon) Arènes (including all Comorian and Indian Ocean *Canthium* Lamarck species), and the Paleotropical *Pyrostria* Commerson ex Jussieu, including *Dinocanthium* Bremekamp (1933), *Leroya* Cavaco (1970), *Neoleroya* Cavaco (Cavaco, 1971), *Pseudopeponidium* Homolle ex Arènes (Arènes, 1960), and *Scyphochlamys* Balfour f. (Balfour, 1877). Here, we present 37 new combinations, of which 20 are in *Peponidium* and the other 17 in *Pyrostria*.

New Combinations and Name in *Peponidium*

Peponidium comprises 47 species, all of which (except the Comorian *P. comorense* Arènes and *P. venulosum* (Boivin ex Baillon) Razafimandimbison, Lantz & B. Bremer) are endemic to Madagascar. The genus is diagnosed by its deciduous, small cupular bracts, which are located at the base of the peduncles and never enclose the young inflorescences. Twenty new combinations are presented below. The replacement *sakalavense* is necessary for *Canthium tsaratananense* Homolle ex Cavaco, as the name already exists as *Peponidium tsaratananense* Arènes (Arènes, 1960) for another species.

1. **Peponidium alleizettei** (Dubard & Dop) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pyrostria alleizettei* Dubard & Dop, as "*P. Alleizetti*," J. Bot., Sér. 2, 3: 24. 1925. *Canthium alleizettei* (Dubard & Dop) Cavaco, Adansonia, Sér. 2, 7: 358. 1967. TYPE: Madagascar. "Forêt de la Mandraka," *C. Alleizette 3–12* (holotype, P 00093493; isotypes, P not seen, photos, P 00093494, P 00093495).
2. **Peponidium andringitrense** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium andringitrense* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 239. 1970–1971 [1972]. TYPE: Madagascar. "Massif de l'Andringitra (Iratsy), Vallées de la Riambava et de l'Antsifotra," *H. Humbert 3764* (holotype, P not seen, photo P 00093499; isotype, P 00093500).
3. **Peponidium ankaranense** (Arènes ex Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium ankaranense* Arènes ex Cavaco, Bull. Mus. Hist. Nat. (Paris), Sér. 2, 39: 1018. 1967 [1968]. TYPE: Madagascar. "Collines et plateaux de l'Ankarana (Province de Diégo-Suarez), forêt tropophile à l'Ouest d'Ambondrofe," 300 m, *H. Humbert 18958* (holotype, P not seen, photo P 00093502; isotype, P 00093503).
4. **Peponidium anoveanum** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium anoveanum* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 220. 1970–1971 [1972]. TYPE: Madagascar. "Rocailles, torrents, bords de la Rivière Anove," 200 m, *H. Perrier de la Bâthie 3972* (holotype, P not seen, photo P 00093505; isotype, P 00093506).
5. **Peponidium arenesianum** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium arenesianum* Cavaco, Bull. Mus. Hist. Nat. (Paris), Sér. 2, 39: 1015. 1967 [1968]. TYPE: Madagascar. "Silve à lichens, Mt. Tsaratanana," 2200 m, *H. Perrier de la Bâthie 16147* (holotype, P not seen, photo P 00093508; isotype, P 00093509).
6. **Peponidium blepharodon** (Arènes ex Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium blepharodon* Arènes ex Cavaco, Adansonia, Sér. 2, 7: 358. 1967. TYPE: Madagascar. "Massif du Manongarivo," *H. Perrier de la Bâthie 3855* (holotype, P 00518172; isotype, P 00518171).
7. **Peponidium boinense** (Arènes ex Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium boinense* Arènes ex Cavaco, Bull. Mus. Hist. Nat. (Paris), Sér. 2, 39: 1019. 1967 [1968]. TYPE: Madagascar. s. loc., *H. Perrier de la Bâthie 3697* (holotype, P 00518188).
8. **Peponidium bosseri** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium bosseri* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 224. 1970–1971 [1972]. TYPE: Madagascar. "Androranga, versant NE," *H. Perrier de la Bâthie 3664* (holotype, P not seen, photo P 00518165; isotype, P 00518166).
9. **Peponidium buxifolium** (Baker) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Plectronia buxifolia* Baker, J. Linn. Soc., Bot. 21: 411. 1885. *Pyrostria buxifolia* (Baker) Hochreutiner, Annuaire Conserv. Jard. Bot. Genève 11: 99. 1908. *Canthium buxifolium* (Baker) Cavaco,

nom. illeg., Adansonia, Sér. 2, 7: 358. 1967. TYPE: Madagascar. s. loc., *R. Baron 3137* (lectotype, designated here, P 00518164; isotype, K not seen).

While describing *Plectronia buxifolia*, Baker (1886: 411) cited six syntypes (*Baron 274*, K not seen; *Baron 969*, K not seen; *Baron 1019*, K not seen; *Baron 2177*, K not seen; *Baron 2213*, K not seen; and *Baron 3137*, K not seen) without designating the type specimen of his new species.

10. **Peponidium cystiporon** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium cystiporon* Bynum ex Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 229. 1970–1971 [1972]. TYPE: Madagascar. Nossi-bé, "Forêt de Loucoubé," *L. H. Boivin 2051/4* (holotype, P 00518159; isotype, P 00518160).
11. **Peponidium decaryi** (Homolle ex Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium decaryi* Homolle ex Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 221. 1970–1971 [1972]. TYPE: Madagascar. "Vallée de l'Ikopa, au nord-ouest d'Ankazobe," *R. Decary 7562* (holotype, P 00518155).
12. **Peponidium humbertianum** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium humbertianum* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 222. 1970–1971 [1972]. TYPE: Madagascar. "Massif du Kalambanitra (centre-sud): Mt. Beanjavidy," *H. Humbert 12047* (holotype, P 00518153; isotypes, P not seen, photos, P 00518151, P 00518152).
13. **Peponidium latiflorum** (Homolle ex Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium latiflorum* Homolle ex Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 221. 1970–1971 [1972]. TYPE: Madagascar. "Analamazaotra," *H. Perrier de la Bâthie 4001* (holotype, P not seen, photo P 00518147; isotype, P 00518148).
14. **Peponidium mandrarense** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium mandrarense* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 238. 1970–1971 [1972]. TYPE: Madagascar. "Bassin de réception de la Mananara, affluent du Mandrare, pentes occidentals des montagnes entre l'Andohahela et l'Elakelaka, au Vatazo (S. d'Imonty)," 900–950 m, *H. Humbert 14062* (holotype, P not seen, photo P 00518140; isotype, P 00518141).
15. **Peponidium marojejyense** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium marojejyense* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 227. 1970–1971 [1972]. TYPE: Madagascar. "Pentes occidentales du Massif de Marojejy (nord-Est), bassin de la Lokoho, à l'Est d'Ambalamanasy II, District d'Andapa, forêt ombrophile sur latérite de gneiss," 450–800 m, *H. Humbert 22140* (holotype, P not seen, photo P 00518142; isotype, P 00518143).
16. **Peponidium sakalavense** Razafimandimbison, Lantz & B. Bremer, nom. nov. Replaced name: *Canthium tsaratananense* Homolle ex Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 230. 1970–1971 [1972], non *Peponidium tsaratananense* Arènes, Not. Syst. (Paris) 16: 38. 1960. TYPE: Madagascar. "Forêt à sous-bois herbacé, Massif de Tsaratanana," 1200 m, *H. Perrier de la Bâthie 15379* (holotype, P 00518030; isotypes, P not seen, photos, P 00518028, P 00518029).

The specific epiphet "*tsaratananense*" cannot be used in combination with *Peponidium*, as it would be a later homonym of *Peponidium tsaratananense* Arènes (Arènes, 1960). The replacement *sakalavense* refers to the name of the native tribe Sakalava, which occupies most of the Sambirano region (including Tsaratanana Mountain).

17. **Peponidium sahafaryense** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium sahafaryense* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 225. 1970–1971 [1972]. TYPE: Madagascar. "Forêt Analafondro, au pied Sud-Est du Plateau de Sahafary (bassin inférieur du Rodo)," *Service Forestier 24513* (holotype, P not seen, photo P 00518036; isotype, P 00518037).
18. **Peponidium subevenium** (K. Schumann) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Plectronia subevenia* K. Schumann, Bot. Jahrb. Syst. 28: 78. 1899. *Pyrostria subevenia* (K. Schumann) Hochreutiner, Annuaire Conserv. Jard. Bot. Genève 11–12: 99. 1908. TYPE: Madagascar. s. loc., *J. Hildebrandt 3917* (holotype, P 00518110).
19. **Peponidium tamatavense** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium tamatavense* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 225. 1970–1971 [1972]. TYPE: Madagascar. Tamatave, "Vohimarangitra," *Réserves Naturelles (Rakotoniaina) 2438* (holotype, P not seen, photo P 00518035; isotypes, P 00518033, P 00518034).
20. **Peponidium venulosum** (Boivin ex Baillon) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium venulosum* Boivin ex

Baillon, Adansonia 12: 221. 1878. TYPE: Mayotte. "Bords de ruisseau de Moussa Péré, dans les bois au pied de la cascade," *L. H. Boivin s.n.* (holotype, P not seen, photo P 00209480).

21. **Peponidium viguieri** (Homolle ex Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium viguieri* Homolle ex Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 227. 1970–1971 [1972]. TYPE: Madagascar. "Forêt d'Analamazaotra," 800 m, *H. Perrier de la Bâthie 6939* (holotype, P 00498791; isotype, P not seen, photo P 00518027).

New Combinations and Names in *Pyrostria*

Pyrostria comprises at least 70 species, of which 42 species plus at least 10 new undescribed species are restricted to Madagascar (Davis & Bridson, 2003; Razafimandimbison et al., in press), 14 species confined to mainland Africa (Bridson, 1987), and eight species endemic to the Mascarenes (Verdcourt, 1983). The number of species of the Southeast Asian *Pyrostria* group B sensu Bridson (1987) is currently unknown. We present 17 new combinations below; replacements are necessary for *Leroya madagascariensis* Cavaco (Cavaco, 1970) and *Pseudopeponidium analamazaotrense* Cavaco (Cavaco, 1966) because names already exist as *Pyrostria madagascariensis* Lecomte (Lecomte, 1922) and *P. analamazaotrensis* Arènes ex Cavaco (Cavaco, 1967), both of which coincidentally pertain to different Malagasy species.

1. **Pyrostria ambongensis** (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium ambongense* Homolle ex Arènes, Not. Syst. (Paris) 16: 23. 1960. TYPE: Madagascar. Soahanina, "sous-bois calcaires près de la mer," *H. Perrier de la Bâthie 3599* (holotype, P 00093803; isotype, P not seen, photo P 00093804).
2. **Pyrostria ampijoroensis** (Arènes) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium ampijoroense* Arènes, Not. Syst. (Paris) 16: 24. 1960. TYPE: Madagascar. [Ouest], "Jardin botanique #4, Ampijoroa-Marovoay," *Service Forestier 7877* (holotype, P 00093807; isotype, P not seen, photo P 00093808).
3. **Pyrostria ankaranensis** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium ankaranense* Cavaco, Adansonia, Sér. 2, 7: 361. 1967. TYPE: Madagascar. "Plateau de l'Ankarana, rochers et lapiaz calcaires dominantes la rive droite de la Rivière d'Andranonakoho (P. k. 103 de la route Diego-Ambilobe)," *Service Forestier 23176* (holotype, P 0093817; isotypes, P 00093818, P 00093819).
4. **Pyrostria antsalovensis** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium antsalovense* Cavaco, Adansonia, Sér. 2, 7: 42. 1967. TYPE: Madagascar. [Ouest], "Forêt et savoka sur sables et grès de Tsimembo vers Tsaranandakana, Ankilomioky et Ambereny (Sud-ouest d'Antsalova)," *J. Léandri 2291* (holotype, P not seen, photo P 00518075; isotypes, P 00518176, P 00518177).
5. **Pyrostria antsirananensis** Razafimandimbison, Lantz & B. Bremer, nom. nov. Replaced name: *Leroyia madagascariensis* Cavaco, Adansonia, Sér. 2, 10: 337. 1970, non *Pyrostria madagascariensis* Lecomte, Bull. Mus. Hist. Nat. 28: 376. 1922. TYPE: Madagascar. [Ouest], "Secteur Nord, au P. k. 10 de la route Diégo Suarez-Orangea," *Service Forestier 22946* (holotype, P 00259370).

The Malagasy genus *Leroya* was originally spelled as "*Leroyia*" by Cavaco (1970). However, the author changed the original spelling to "*Leroya*" when describing his new genus *Neoleroya* (Cavaco, 1971). The replacement *antsirananensis* is based on the name of the northern province of Madagascar, to which the species is restricted.

6. **Pyrostria asosa** (Arènes) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium asosa* Arènes, Not. Syst. (Paris) 16: 22. 1960. TYPE: Madagascar. [Sud-Est], "Haniliha-Fort-Dauphin," *Réserves Naturelles 6741* (holotype, P 00259381).
7. **Pyrostria capuronii** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium capuronii* Cavaco, Adansonia, Sér. 2, 7: 359. 1967. TYPE: Madagascar. [Extrême limite orientale], "Pentes moyennes et supérieures (entre 300 et 500 m) du Massif du Vohitsiandriana (au sud-ouest de Fort-Dauphin)," *Service Forestier 22390* (holotype, P not seen, photo P 00518071; isotype, P 00518072).
8. **Pyrostria ixorifolia** (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium ixorifolium* Homolle ex Arènes, Not. Syst. (Paris) 16: 22. 1960. TYPE: Madagascar. s. loc., *R. Baron 6619* (holotype, P 00518182).
9. **Pyrostria longiflora** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium longiflorum* Cavaco, Bull. Mus. Hist. Nat., Sér. 2, 38: 701. 1966. TYPE: Madagascar. "Fort-Dauphin, Réserves Naturelles," *Réserves Naturelles 7480* (holotype, P 00518183; isotype, P 00518184).

10. **Pyrostria louvelii** Razafimandimbison, Lantz & B. Bremer, nom. nov. Replaced name: *Pseudopeponidium analamazaotrense* Cavaco, Bull. Mus. Hist. Nat., Sér. 2, 38: 700. 1966, non *Pyrostria analamazaotrensis* Arènes ex Cavaco, Bull. Mus. His. Nat., Sér. 2, 39: 1018. 1967 [1968]. TYPE: Madagascar. "Forêt d'Analamazaotra," *M. Louvel 133* (holotype, P 00518181).

The new epithet *louvelii* honors Modeste Louvel, a French forester based in Madagascar for nearly 40 years (1901–1939) (Dorr, 1997) who collected the type specimen.

11. **Pyrostria neriifolia** (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium neriifolium* Homolle ex Arènes, Not. Syst. (Paris) 16: 23. 1960. TYPE: Madagascar. [Ouest], "Environs de Majunga," *H. Perrier de la Bâthie 1661* (holotype, P 00518218; isotype, P 00518219).
12. **Pyrostria oleifolia** (Homolle ex Arènes) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium oleifolium* Homolle ex Arènes, Not. Syst. (Paris) 16: 24. 1960. TYPE: Madagascar. Prov. Diégo-Suarez, "Analamerana," 50–400 m, *H. Humbert 19146* (holotype, P 00518086).
13. **Pyrostria perrieri** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Canthium perrieri* Cavaco, Portugaliae Acta Biol., Sér. B, Sist. 11: 240. 1970–1971 [1972]. TYPE: Madagascar. "Forêt d'Analamazaotra," 800 m, *H. Perrier de la Bâthie 6890* (holotype, P 00518131; isotypes, P not seen, photos, P 00518132, P 00518133, P 00518134).
14. **Pyrostria revoluta** (Balfour f.) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Scyphochlamys revoluta* Balfour f., J. Linn. Soc., Bot. 16: 14–15. 1877. TYPE: Rodrigues. *I. Balfour s.n.* (lectotype, designated by Verdcourt, 1983: 567, K; isotype, S).

The inclusion of *Scyphochlamys revoluta* in *Pyrostria* is based on its phylogenetic position within *Pyrostria* according to Razafimandimbison et al. (in press). In addition, the presence of an involucre in this species is interpreted as a further development of the persistent and basally connate, long-acuminate, paired bracts subtending the inflorescences of other *Pyrostria* species.

15. **Pyrostria richardiae** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Leroya richardiae* Cavaco, Kew Bull. 28: 349–350. 1973. TYPE: Madagascar. [Western region], "Ampijoroa, Ankarafantsika, Jardin botanique," *A. Richard 800* (holotype, K).
16. **Pyrostria sambavensis** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium sambavense* Cavaco, Adansonia, Sér. 2, 9: 45. 1969. TYPE: Madagascar. [Nord-Est], "Forêt littorale, sur sable, au Sud de Sambava," *Service Forestier 24925* (holotype, P 00518178; isotypes, P not seen, photos, P 00498793, P 00518179).
17. **Pyrostria suarezensis** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium suarezense* Cavaco, Adansonia, Sér. 2, 9: 45. 1969. TYPE: Madagascar. [Nord], Diégo-Suarez, s. loc., *Service Forestier 6206* (holotype, P 00518180).
18. **Pyrostria tulearensis** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Pseudopeponidium tulearense* Cavaco, Adansonia, Sér. 2, 9: 43. 1969. TYPE: Madagascar. "Région de Tuléar, Ankazoabo," *R. Decary 16266* (holotype, P 00518177).
19. **Pyrostria verdcourtii** (Cavaco) Razafimandimbison, Lantz & B. Bremer, comb. nov. Basionym: *Neoleroya verdcourtii* Cavaco, Adansonia, Sér. 2, 11: 122. 1971. TYPE: Madagascar. [Ouest], "Secteur Nord, entre Antsakoabe et Anivorano-Nord (au P. k. 67 de la route de Diégo-Suarez-Ambilobe)," *Service Forestier 23115* (holotype, P 00259372; isotypes, P not seen, photos, P 00518189, P 00518190).

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A New Species of *Matelea* (Apocynaceae, Asclepiadoideae) from Trans-Pecos, Texas, U.S.A.

R. E. Rintz

RR 4, Box 510, Salem, Missouri 65560, U.S.A. rasasiang@hotmail.com

Abstract. *Matelea atrostellata* Rintz (Apocynaceae, Asclepiadoideae), a new species from Trans-Pecos, Texas, U.S.A., is described and illustrated. This species is very similar vegetatively to *M. producta* (Torrey) Woodson and *M. texensis* Correll, but is readily distinguished floristically by its rotate corolla and its nearly black corona. Both *M. producta* and *M. texensis* have campanulate corollas and very pale green or white coronas. This is the fifth species of *Matelea* Aublet to be recorded from Brewster County, Texas.

Key words: Apocynaceae, Asclepiadoideae, IUCN Red List, *Matelea*, Trans-Pecos, Texas.

The genus *Matelea* (Apocynaceae, Asclepiadoideae) was originally established by Aublet in 1775 to accommodate two species of plants that he found in French Guiana, *M. palustris* Aublet and *M. latifolia* Aublet. It currently comprises ca. 100 species occurring mainly in Central America, but about 20 species also occur in the southern regions of the United States as far north as central Tennessee, Missouri, Oklahoma, New Mexico, and Arizona. At least eight of these species are endemic to the United States (Drapalik, 1969; Turner, 2003). The plants are either vines or form decumbent rosettes of short stems from a central rootstock. All the U.S. species have leaves with cordate bases, and on most of them the indumentum is comprised of a mixture of long, stiff trichomes and short, glandular ones (Stevens, 1976). The climbing species generally have smooth fruits, sometimes with rounded projections, pale in color with dark lines, while the decumbent species have rough, spiny fruits of a uniform color. *Matelea atrostellata* Rintz is the fifth climbing species recorded from Brewster County, Texas, the others being *M. reticulata* (Engelmann ex A. Gray) Woodson, *M. parvifolia* (Torrey) Woodson, *M. producta* (Torrey) Woodson, and *M. texensis* Correll.

Matelea atrostellata Rintz, sp. nov. TYPE: U.S.A. Texas: Brewster Co., Big Bend Natl. Park, Chisos Mtns., Oak Canyon, twining in shrubs along the middle of Window Trail, ca. 1540 m, 15 Aug. 2005, *R. E. Rintz 2005-1* (holotype & color photo, SRSC; isotype & color photo, MO). Figure 1.

Planta scandens 1–2 m longa; caulis gracilis ca. 1 mm diam., puberulus. Folia petiolis puberulis ca. 1 cm longis, laminis membranaceis, basibus cordatis, lobis magnis, apicibus attenuatibus, in superficiebus folii ambabus puberulis, 3–6 × 1.5–3 cm. Inflorescentiae pedunculis ca. 1 cm longis, simul 1 vel 2 floribus, pedicellis ca. 1 cm longis, puberulis. Corolla rotata, ca. 13–15 mm diam., colore pallide aurantiaco vel atropurpureo; corona saturatissime atropurpurea, elatior quam stigmata, ca. 1 mm alta; corona exterior brevi-cylindrata, quinque-lobata; corona interior calcaribus 5 antheris oppositis. Folliculi glabri, 8–10 × 1.5–2 cm, pallide virides, lineis atroviridibus ornati.

A twining vine producing stems annually from a perennial rootstock of undetermined form; *stems* ca. 1 mm diam., from 1–2 m, glandular-pubescent. *Leaves* with glandular-pubescent petioles ca. 1 cm; laminae membranous, bases cordate with large lobes, tips attenuate, both sides pubescent, 3–6 × 1.5–3 cm. *Inflorescences* from extra-axillary peduncles ca. 1 cm, bearing 1 or 2 flowers at a time on glandular-pubescent pedicels ca. 1 cm. *Calyx* lobes lanceolate, ca. 3 × 1.5 mm, glandular-pubescent outside, glabrous inside; *corolla* rotate, ca. 13–15 mm diam., color varying from pale orange to very dark red or dark green, sometimes appearing nearly black, lobes ca. 5–6 mm, glabrous above on some, on others with numerous large, incurved trichomes extending from the base to 2/3 or 3/4 length of lobes, pilose below without glandular hairs; outer *corona* a short, 5-lobed cylinder rising ca. 1 mm above corolla with an inner corona of 5 spurs opposite and closely appressed to anthers and partly overarching them; the rim of corona cylinder and inner corona spurs with numerous papillae possibly functioning as osmophores; the corona slightly taller than the short gynostegium, very dark red to black, usually darker than corolla, the apex of stigma appearing as a white dot in a dark ring; *stigma* flat with a central depression; *anther* appendages short, leaving stigmatic center uncovered; *corpusculum* spatulate, ca. 0.25 mm, dark brown; translators short, twisted, attached perpendicular to corpusculum; pollinia round-ovate, ca. 0.5–0.6 mm diam. with a short wing at the bottom. *Follicles* pendant, smooth, 8–10 × 1.5–2 cm, pale green or

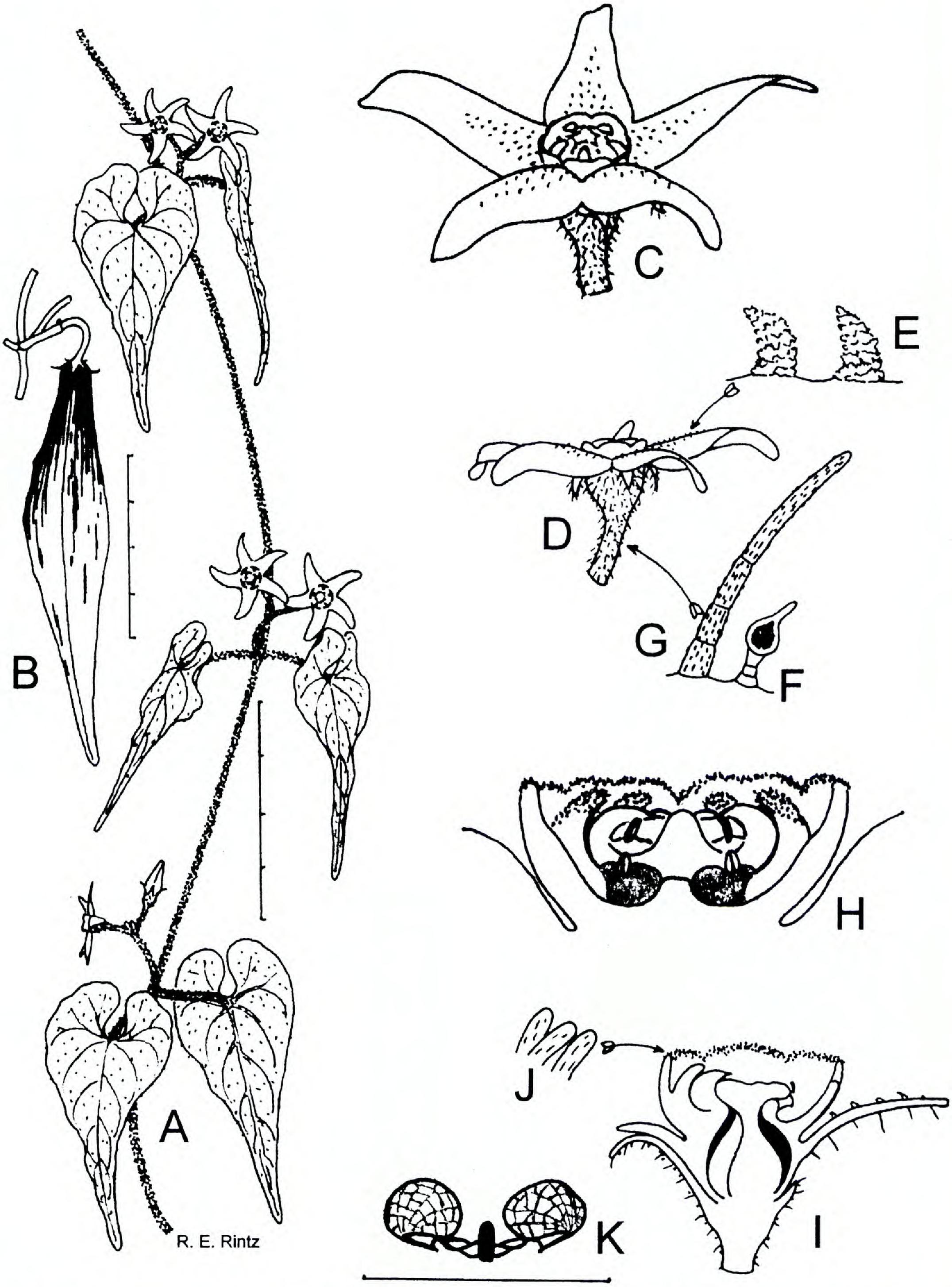

Figure 1. *Matelea atrostellata* Rintz. —A. Habit (scale = 4 cm). —B. Fruit (scale = 4 cm). —C, D. Flower in oblique and side views. —E. Corolla trichomes. —F. Glandular trichome from sepals and pedicel. —G. Long, stiff trichome from sepals and pedicel. —H. Gynostegium with front portion of corona cut away. —I. Radial section of flower. —J. Papillae from rim of corona. —K. Pollinarium (scale = 1 mm). A from *R. E. Rintz 2005-1* (SRSC); B from photo (SRSC); all others from flowers in liquid (SRSC).

gray with dark green lines; seeds oval, entire with a coma.

Note: The author was in the company of A. M. Powell, and the type collection was made on his park permit BIBE-2001-SCI-0029.

Relationships. *Matelea atrostellata* is one member of a trio of species that also includes *M. producta* and *M. texensis*. Currently, *M. atrostellata* and *M. texensis* are known only from Brewster County, while *M. producta* is also known from there, but extends northward at least as far as central New Mexico. These three species are remarkably similar in their habits. All are small vines twining into shrubs, have cordate-attenuate leaves, are glandular-pubescent, and have virtually identical fruits. They also share a cylindrical five-lobed outer corona that has an inner corona of five spurs behind or overarching the anthers. The upper margin of the outer corona lobes is papillose as is the spur of the inner corona. In *M. producta* the outer corona is shorter than the gynostegium; in *M. atrostellata* it is slightly higher, and in *M. texensis* it is twice as high with an inner corona of five well-developed papillose spurs. Both *M. producta* and *M. texensis* have grass green, campanulate corollas, but the former is glabrous within and the latter is velutinous. (In August 2006, I found several specimens of *M. producta* at the Davis Mountains Preserve of The Nature Conservancy in Jeff Davis County, which had deep red corollas with white coronas. A specimen (*R. E Rintz 2006-2*) is deposited at SRSC. This suggests a further link between the two species.) In *M. atrostellata* the corolla is rotate, sometimes with short, thick trichomes on the inner surface, and is often a very dark red or dark green color.

Etymology. The specific epithet *atrostellata*, or dark-starred, refers to the usually dark green to dark red to nearly black corolla.

Ecology, conservation assessment, and IUCN Red List category. As of this writing, *Matelea atrostellata* is known only from a single population in a sky-island canyon with a well-traveled nature trail. I visited the population in August of 2004, 2005, and 2006 and each time found plants in flower and fruit. No plants were found away from the trail. While there seemed to be fewer than 100 plants, the population appeared stable and healthy to me. No additional specimens of the new species were seen at SRSC or at MO. On this basis it might be appropriate to list the plant as Vulnerable, VU D1 and 2, according to the IUCN (2001) Red List criteria.

Additional comments. *Matelea atrostellata* is host to a rust fungus that stunts the plant, thickens and yellows its leaves, and distorts its flowers. Tiny black hemispherical spots appear on the adaxial and abaxial leaf surfaces, petioles, and stems. They contain clusters of two-celled, orange-brown teliospores. White pustules appear on the abaxial leaf surface and rupture to release large numbers of what seem to be single-celled, clear uredospores. If this interpretation is correct, there should be an alternate host nearby.

Acknowledgments. This study was made possible by the generosity of my father, Edward J. Rintz. I extend my thanks to Shirley and Michael Powell, W. D. Stevens, and Victoria C. Hollowell for their assistance and encouragement, to the four reviewers for their useful suggestions, and to Karen D. Smith for her assistance with the manuscript.

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Meriania aurata (Melastomataceae), una Especie Nueva de los Llanganates, Ecuador

Carmen Ulloa Ulloa
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
carmen.ulloa@mobot.org

Diana Fernández Fernández
Herbario de la Escuela Politécnica de Chimborazo (CHEP), Riobamba, Ecuador.
fernandezdiana@yahoo.com

David A. Neill
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A. and Herbario Loja, Universidad Nacional de Loja, Casilla 11-01-249, Loja, Ecuador.
david.neill@mobot.org

Resumen. Se describe e ilustra una especie nueva, *Meriania aurata* C. Ulloa, D. Fernández & D. A. Neill (Melastomataceae) del Parque Nacional Llanganates, Ecuador. Se parece a *M. hernandoi* L. Uribe; ambas especies tienen hojas de gran tamaño con la base de la lámina auriculada y con un escudo en la inserción del pecíolo, la inflorescencia robusta, el cáliz amarillo, los pétalos anaranjados y las tecas moradas, pero la especie nueva se distingue por tener dientes calicinos externos conspicuos y coriáceos, aurículas conspicuas y el escudo sólo adaxial.

Abstract. *Meriania aurata* C. Ulloa, D. Fernández & D. A. Neill (Melastomataceae) from the Llangantes National Park, Ecuador, is described and illustrated. It resembles *M. hernandoi* L. Uribe; both species have large leaves with an auriculate base and a scutum at the petiole insertion, a robust inflorescence, yellow calyx, orange petals, and purple thecae, but the new species is distinguished by the conspicuous coriaceous external calyx teeth, conspicuous auricles, and scutum present only adaxially.

Key words: Andes, Ecuador, IUCN Red List, Llanganates, Melastomataceae, *Meriania*, Merianieae.

Meriania Swartz es un género con alrededor de 75 especies distribuidas desde el sur de México (Chiapas) hasta el sureste de Brasil y en las Antillas (Almeda, 1993; Renner, 1993). Es el género más grande dentro de la tribu Merianieae. Su afinidad con *Adelobotrys* DC., *Axinaea* Ruiz & Pavón, *Centronia* D. Don y *Graffenrieda* DC., así como la necesidad de una evaluación profunda para resolver los problemas de delimitación genérica, ya lo han manifestado varios autores (Triana, 1871; Wurdack, 1973; Balslev, 2003; Schulman & Hyvönen, 2003). En Ecuador el género está representado por 28 especies (Wurdack, 1980; Renner, 1999). Las especies de *Meriania* son arbustos o árboles, con flores perígenas, 5–6(–8)-meras, generalmente agregadas en tirsoides terminales, ocasionalmente solitarias o ternadas; hipanto terete o acostillado; cáliz entero o lobulado, persistente en la antesis, con dientes externos desarrollados u obsoletos; pétalos vistosos, de color rosado, magenta, púrpura, morado o rara vez anaranjado; estambres isomorfos o más o menos dimorfos, glabros, las tecas subuladas con un poro dorsalmente inclinado, el conectivo generalmente algo prolongado y con una espuela dorso-basal y algunas veces también con un apéndice dorsal ascendente; estilo glabro; ovario libre, 3–6-locular. Cápsula 5–6-valvada; semillas numerosas (Wurdack, 1973, 1980).

Entre las colecciones del remoto Parque Nacional Llanganates en la Cordillera Oriental de los Andes ecuatorianos se ha descubierto una especie nueva que describimos a continuación.

Meriania aurata C. Ulloa, D. Fernández & D. A. Neill, sp. nov. TIPO: Ecuador. Tungurahua: Cantón Baños: Parque Nac. Llanganates, Cordillera Sacha Llanganates, ridge above Río Zuñac, dense elfin forest, granite substrate, 2340 m, 01°21′45″S, 78°08′25″W, 27 Nov. 2001, *D. Neill, L. Jost, J. Caranqui & E. Toapanta 13423* (holotipo, QCNE; isotipos, AAU, M, MO, QCA, US). Figura 1.

Haec species *Merianiae hernandoi* L. Uribe similis, sed ab ea dentibus calycinis externis grandibus obtusis, foliis glabris atque scuto calloso auriculato laminae ad basin

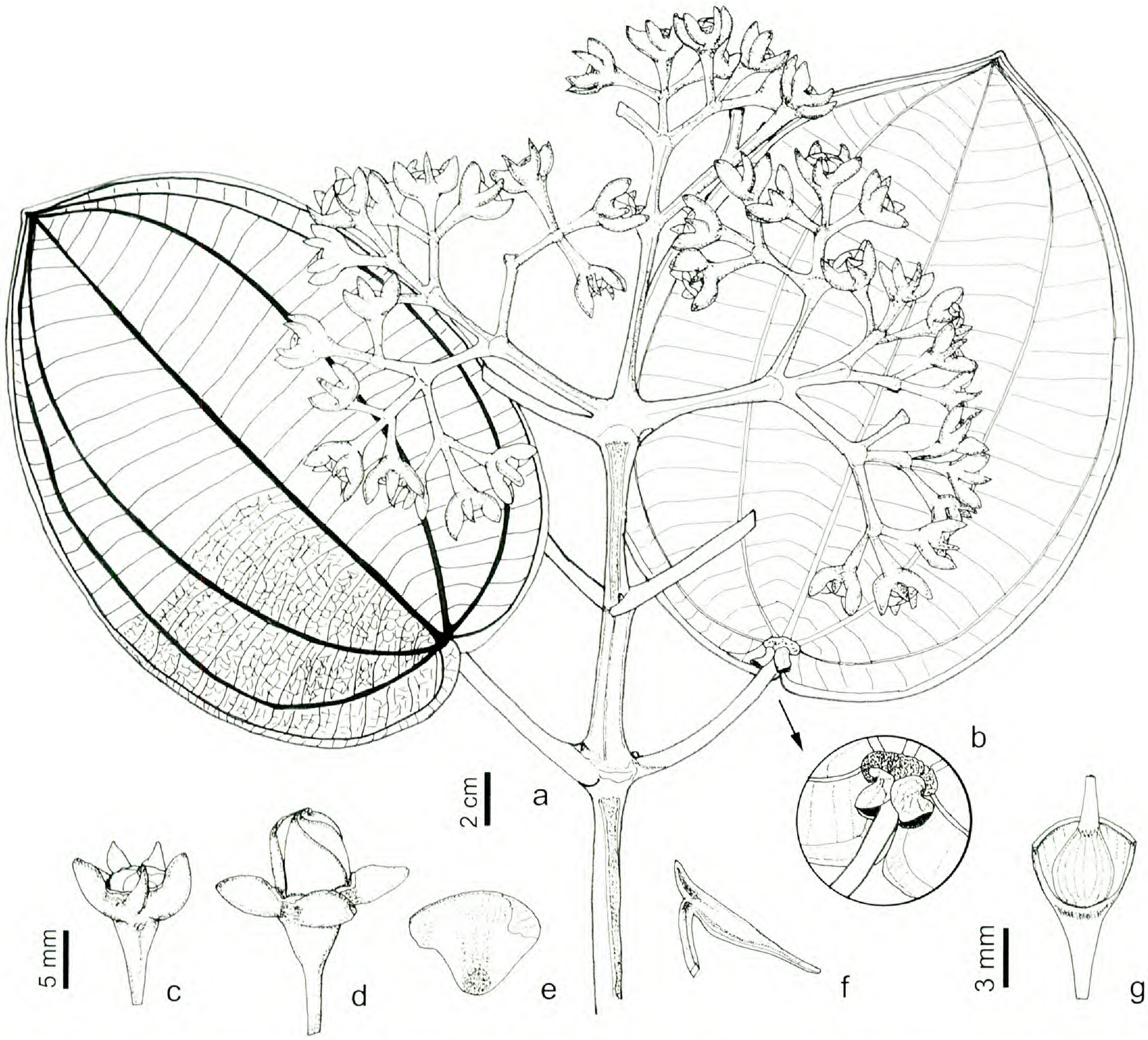

Figura 1. *Meriania aurata* C. Ulloa, D. Fernández & D. A. Neill. —a. Hábito con vista de la lámina por el lado abaxial (envés) a la izquierda y el adaxial (haz) a la derecha. —b. Detalle de la base auriculada con el escudo por el lado adaxial de la lámina. —c. Botón floral. —d. Flor en antesis temprana. —e. Detalle del pétalo en antesis temprana. —f. Estambre (de botón floral joven), vista lateral. —g. Gineceo (de botón floral joven). c–e a la misma escala, f y g a la misma escala. Ilustrada por D. Fernández y C. Ulloa de la colección tipo, *Neill et al. 13423*.

latere adaxiali tantum petioli apicem non omnino cingente differt.

Árbol de 15 m, con tricomas microscópicos de ca. 0.1 mm en la lámina, en las nervaduras de las hojas y brácteas (especialmente en el envés) y en la base de los pedicelos, más esparcidos en los tallos, pecíolos y ejes de las inflorescencias, ocasionalmente encontrados en la superficie exterior del hipanto y en los lóbulos exteriores del cáliz, pubescencia furfurácea caediza a lo largo de los nervios (especialmente en el haz), en los nudos de los tallos y en la base de los pedicelos; tallos cuadrangulares, acanalados cuando secos; ramas con nudos estipulares abultados; estípulas lineares, 2 mm. Pecíolos 5–6 cm de largo, 3–5 mm de grosor; hojas isomorfas, la lámina 13.5–25 × 11.5–18 cm, densa y uniformemente punteada con papilas microscópicas más o menos hemisféricas de ca. 0.1 mm de diámetro, coriácea, entera, anchamente ovado-elíptica, el ápice anchamente agudo a obtuso, la base profundamente cordado-amplexicaule, con los lóbulos basales imbricados abaxialmente, rodeando al pecíolo y formando dos aurículas por el lado adaxial, las aurículas 7–20 mm de ancho, ligeramente oblicuas, un escudo grueso presente en la inserción de la base de la lámina con el pecíolo por el lado adaxial, 7–14 × 2–3 mm, a manera de una callosidad conspicua, verrugosa, semianular; nervadura acródroma basal, 7-nervia (el par marginal inconspicuo), prominente en ambos lados, las venas secundarias separadas entre sí 3–8 mm, impresos en el haz, prominentes en el envés, las vénulas reticuladas. Inflorescencia un tirsoide triple, 20–27 cm (incl. el

Tabla 1. Comparación de algunos caracteres morfológicos entre especies afines a *Meriania aurata*.

Caracteres	*M. aurata*	*M. campii*	*M. hernandoi*
Lámina (cm)/No. nervios principales	13.5–25 × 11.5–18/5–7	6–12 × 4–8/5	22–41 × 19–37/5–7
Base de la lámina	profundamente cordada-amplexicaule	obtusa a redondeada	cordada
Aurículas, ancho (mm)	adaxiales, 7–20	ausentes	adaxiales, 3–5
Escudo	adaxial	ausente	rodea al pecíolo
Bractéolas	ausentes	ausentes	hasta 15 mm
Hipanto	terete, 18–25 mm	acostillado, ca. 4 mm	terete, 8–9 mm
Dientes calicinos externos	8–14 mm	1.5–4 mm	ca. 2 mm
Pétalos, color	anaranjado	rosado	anaranjado
Distribución	Tungurahua, Ecuador	Morona-Santiago, Ecuador	Putumayo, Colombia; Napo, Ecuador
Pliego estudiado	*Neill et al. 13423* (AAU, M, MO, QCA, QCNE, US)	*Camp E-4919* (MO, P)	*Hammel 15918* (MO), *Neill 12902* (MO, QCNE)

pedúnculo), formada por tríades, multifloras, hasta con alrededor de 60 flores, con un par de brácteas foliáceas basales, 10.5 × 8.5 cm, de forma similar pero más pequeñas que las hojas; bractéolas ausentes. Flores 5-meras; pedicelos 15–17 mm, gruesos, verde oscuros; hipanto 18–25 mm, campanulado, terete; tubo del cáliz 5–6 mm, amarillo intenso con tintes verde claro, los dientes interiores evidentes en forma de un borde ondulado de 1–1.5 mm, los dientes exteriores prominentes, 8–14 × 4–6 mm, ovado- a obovado-triangulares, romos, recurvados hacia arriba en el botón y luego patentes, coriáceos, de un amarillo intenso; pétalos 17–23 × 25–27 mm, obovados, glabros, anaranjados, carnosos; estambres 10, isomorfos, los filamentos ca. 5 mm (medidas en botones florales jóvenes), las tecas 7–8 mm, moradas, con un poro dorsalmente inclinado, el espolón dorso-basal, 2.5–3 mm, el conectivo sin otros apéndices; ovario 5-locular, acostillado, el ápice con lóbulos bidentados en la base del estilo, el estilo ca. 3 mm, grueso, truncado, la placenta axilar, pediculada y con forma de yunque, ocupando toda la cavidad del lóculo, ovarios diminutos, numerosos. Frutos maduros no vistos.

Meriania aurata se parece principalmente a *M. hernandoi* L. Uribe porque las dos especies tienen el cáliz amarillo, los pétalos anaranjados y las tecas de las anteras moradas. En ambas especies las hojas son de gran tamaño y la lámina presenta aurículas adaxiales y un escudo en la inserción del pecíolo. Las aurículas en *M. aurata* son grandes y el escudo se encuentra sólo por el lado adaxial. Tradicionalmente se aplica el término "escudo" ("scutum" en latín) a la estructura que se forma por los márgenes de la base de la lámina foliar al unirse con el ápice del pecíolo, observado en relativamente pocas especies de *Axinaea* y *Meriania* (véase Wurdack, 1973, 1980; Balslev, 2003). Ninguna de las flores en antesis presentó estambres, por lo que se piensa que caen muy temprano. Las diferencias entre estas dos especies y *M. campii* Wurdack que también tiene dientes calicinos carnosos se encuentra en la Tabla 1.

Hábitat, distribución, fenología y conservación. Esta especie se conoce únicamente de los bosques andinos de la Cordillera Oriental de Ecuador en el Parque Nacional Llanganates, provincia del Tungurahua. Se la ha recolectado en la zona conocida como Sacha Llanganates sobre sustrato granítico. Aunque sólo se conoce en material de herbario por la colección tipo, la especie es común en el área pero no se conocen poblaciones en otros sitios. Se le asigna la categoría de NT (Casi Amenazada) según la UICN (2001). Se ha recolectado con flor en noviembre. Una fotografía del hábito se encuentra en www.tropicos.org.

Etimología. El nombre de la especie significa ornamentada de oro, por el color amarillo profundo del cáliz y los pétalos anaranjados. Conmemora además la antigua leyenda del oro de los Llanganates: el fabuloso tesoro de Quito destinado para pagar el rescate del emperador inca Atahualpa, apresado por los españoles, pero que el general Rumiñahui supuestamente habría escondido en estas montañas cuando recibió la noticia de la ejecución de su emperador y el avance de los codiciosos conquistadores. Ese oro nunca se ha encontrado; sin embargo, con el nombre de esta especie queremos señalar que el verdadero gran tesoro es la incomparable prodigiosa naturaleza y biodiversidad de la zona.

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A New Combination in *Glossopetalon* (Crossosomataceae)

George Yatskievych
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.
george.yatskievych@mobot.org

Abstract. As part of research leading to a treatment of the family Crossosomataceae for the Flora of North America Project, the new combination *Glossopetalon spinescens* (A. Gray) Greene var. *planitierum* (Ensign) Yatskievych is proposed to account for plants in the *G. spinescens* complex endemic to a small portion of the United States in the Texas Panhandle and adjacent Colorado, New Mexico, and Oklahoma. The change in status from species to variety is justified in light of the subtle patterns of morphological variation within the complex as a whole, which in recent decades has resulted in the reclassification of several other former species of *Glossopetalon* A. Gray as varieties of *G. spinescens*.

Key words: Central United States, Crossosomataceae, Flora of North America, *Glossopetalon*.

Glossopetalon A. Gray is a genus of shrubby plants inhabiting dry sites in the western half of the United States and portions of northern and eastern Mexico. The genus has endured taxonomic and nomenclatural controversies at the generic and specific levels and also concerning its familial affiliation. Classification of *Glossopetalon* in the Crossosomataceae (rather than the Celastraceae) has now been well documented, based on analyses of morphology (Thorne & Scogin, 1978), wood anatomy (DeBuhr, 1978), phytochemistry (Tatsuno & Scogin, 1978), and *rbcL* sequence data (Sosa & Chase, 2003). Nomenclatural issues surrounding the availability and priority of *Glossopetalon* (vs. *Forsellesia* Greene) also have been resolved (St. John, 1942; Holmgren, 1988, 1997).

However, species limits within *Glossopetalon* are still not well understood. The only comprehensive treatment of the genus to date was that of Ensign (1942), who accepted eight species (as *Forsellesia*). Subsequently, some botanists working with regional floras have suggested that the lack of discrete morphological characters distinguishing various taxa may support possible future mergings, including the works of Lundell (1969) on the Texas flora and Welsh et al. (1987) on the Utah flora.

The most insightful morphological analysis thus far has been that of Holmgren (1988, 1997) involving the taxa of the intermountain region of the western United States, who concluded that some of the characters used in the existing literature are somewhat overlapping between taxa and that *Glossopetalon* should be reduced from eight to four or five species. Holmgren noted the variability and intergradation among populations for characters such as leaf size and degree of stipule development and adnation; he reduced three of Ensign's (1942) species to varieties or synonyms within *G. spinescens* A. Gray, also naming an additional new variety. Some botanists, for example Shevock (1993), even have questioned whether infraspecific taxa should be recognized at all within *G. spinescens*.

Holmgren (1988) noted two additional members of the *Glossopetalon spinescens* complex that he did not examine because they occur only outside of the intermountain region. Ensign (1942) treated one of these as *Forsellesia spinescens* (A. Gray) Greene var. *mexicana* Ensign (*G. spinescens* var. *mexicanum* (Ensign) H. St. John), but she knew this plant only from a single herbarium specimen from Coahuila, Mexico. After examining an isotype (Mexico, Coahuila, Sierra de Pata Galana, Feb. 1905, *Purpus 1120*, MO) and a second more recent collection (Mexico, Coahuila, 3 km SW of Fraile, 11 July 1941, *Stanford, Retherford & Northcraft 316*, MO), I am inclined to agree with the varietal designation for this taxon within *G. spinescens*. With its small leaves and relatively well-developed stipules, the variety *mexicanum* resembles *G. spinescens* var. *microphyllum* N. H. Holmgren, which is endemic to portions of Arizona, Nevada, and Utah in the Great Basin region. The latter taxon appears to differ from the one in Mexico mainly in its stem coloration, which tends to change from green to orangish brown on second-year branches, and in its somewhat shorter (25–60 cm) habit.

Ensign (1942) described *Forsellesia planitierum* to circumscribe a small group of populations endemic to the southwestern portion of the American Great Plains in the Texas Panhandle and a few adjacent counties in Colorado, New Mexico, and Oklahoma. She aligned her new species with *F. nevadensis* (A. Gray) Greene (*Glossopetalon spinescens* var. *aridum* M. E. Jones) and *F. spinescens* (*G. spinescens* var. *spinescens*). From these, she distinguished it by its thinner, grayer

branches, somewhat less spinescent branch tips, and its slightly broader petals.

In compiling an account of *Glossopetalon* for an upcoming volume of the *Flora of North America* series, it seems most reasonable to follow Holmgren's (1988, 1997) treatment of the *G. spinescens* complex as a series of populations in which isolated populations with apparent lack of gene flow have contributed to subtle patterns of morphological divergence best recognized taxonomically at the varietal level. A key to these varieties will be included in the forthcoming account in the *Flora of North America* series (Mason & Yatskievych, in prep.). Combinations have been published to account for all of the taxa in the complex that formerly were recognized as species by Ensign (1942) except for the one in the southwestern Great Plains. This is published here, as follows:

Glossopetalon spinescens var. **planitierum** (Ensign) Yatskievych, comb. et stat. nov. Basionym: *Forsellesia planitierum* Ensign, Amer. Midl. Naturalist 27: 509. 1942. *Glossopetalon planitierum* (Ensign) H. St. John, Proc. Biol. Soc. Washington 55: 112. 1942. TYPE: U.S.A. Oklahoma: Cimarron Co., high up on side of Black Mesa, near Kenton, 14 May 1913, *G. W. Stevens 463* (holotype, GH; isotypes, A, DS, US).

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Erratum

O'Kane S. L., Jr. *Physaria scrotiformis* (Brassicaceae), a New High-Elevation Species from Southwestern Colorado and New Combinations in *Physaria*. Novon 17: 376–382.

In a previous publication (O'Kane, 2007: 381), the combination *Physaria lepidota* Rollins subsp. *membranacea* (Rollins) O'Kane was made. That combination, however, was based on a nonexistent basionym, *P. membranacea* Rollins, and is invalid according to Article 33.4 of the *International Code of Botanical Nomenclature* (McNeil, 2006). Below, a corrected combination is made.

Physaria lepidota Rollins subsp. **membranacea** (Rollins) O'Kane, comb. et stat. nov. Basionym: *Physaria chambersii* Rollins var. *membranacea* Rollins, Rhodora 41: 404. 1939. *Physaria lepidota* Rollins var. *membranacea* Rollins, Brittonia 33: 338. 1981. TYPE: U.S.A. Utah: Kane Co., steep chip-rock slide, 1/4 mi. W of jct. of Utah Hwy. 15 & U.S. Hwy. 89, betw. Kanab & Zion Natl. Park, 20 mi. E of park entrance, 10 June 1979, *R. C. Rollins & K. W. Rollins 79198* (holotype, GH; isotypes, BRY, NY, RM, UC, US).

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